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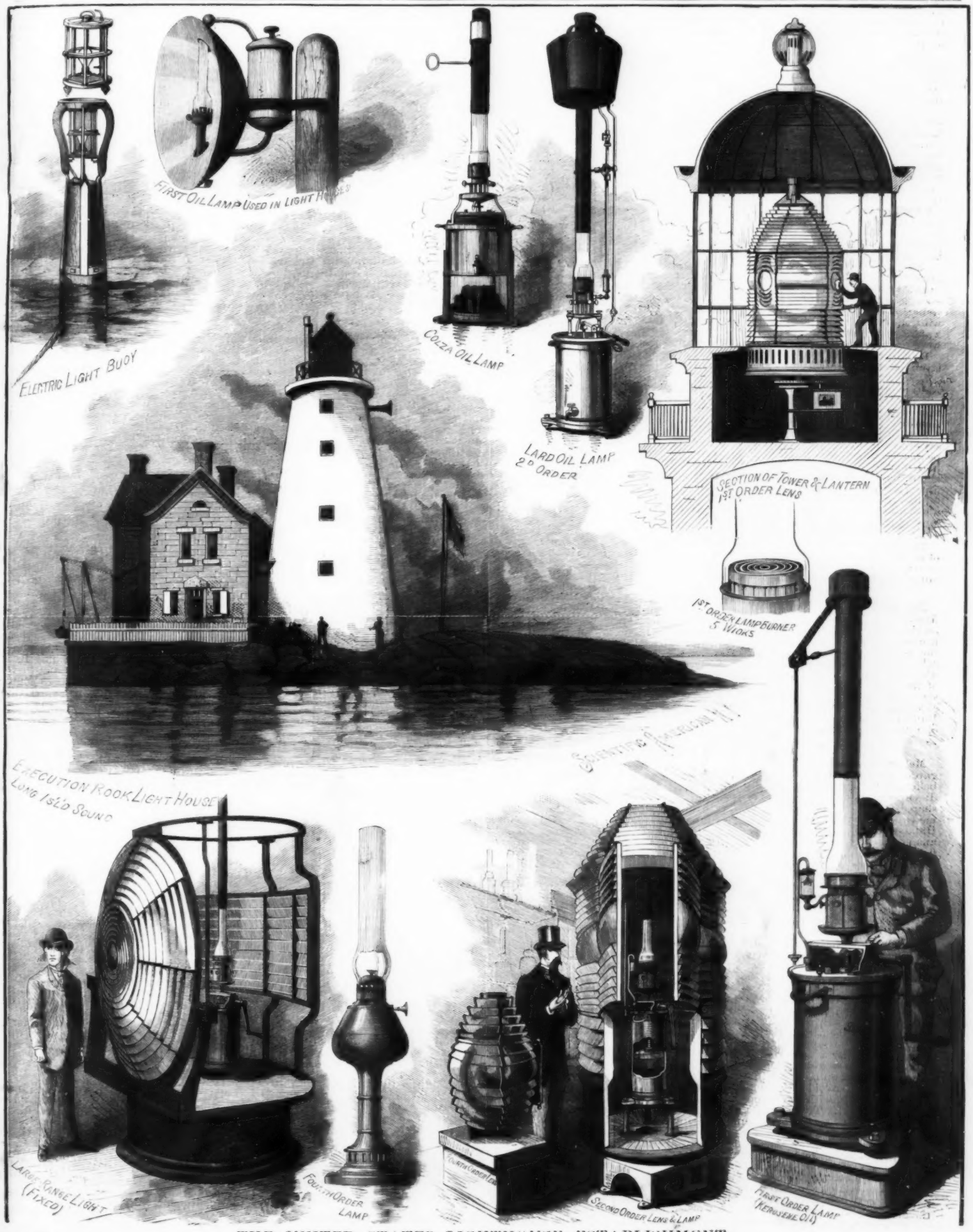

ELECTRIC LIGHT BUOY
FIRST OIL LAMP USED IN LIGHT HOUSES
COLZA OIL LAMP
LARD OIL LAMP 2D ORDER
SECTION OF TOWER & LANTERN 1ST ORDER LENS
1ST ORDER LAMP BURNER 5 WICKS
EXECUTION ROCK LIGHT HOUSE LONG ISLD SOUND
LARGE RANGE LIGHT (FIXED)
FOURTH ORDER LAMP
SECOND ORDER LENS & LAMP
FIRST ORDER LAMP (KEROSENE OIL)

THE UNITED STATES LIGHTHOUSE ESTABLISHMENT.

LIGHTHOUSE, BUOY AND LIGHTSHIP ILLUMINATION.

In the present day, the majority of lighthouses in the United States or practically all depend upon kerosene oil as their illuminant. In old times, the first representatives of warning lights on shore may be supposed to have been bonfires, succeeded in their turn by braziers. It is believed that the Colossus of Rhodes held in his upstretched hand a brazier in which a fire was maintained to guide vessels into the harbor. His modern successor, the Goddess of Liberty, in the harbor of New York, carries an electric torch, in virtually the same position that her prototype is supposed to have held his brazier. Candles also played their part in the illumination of lighthouses, but in modern days everything has given way to the oil lamp, with very few and isolated exceptions.

A representative of the early oil lamp is shown in the cut. This was adapted to burn lard oil, and in order to prevent the oil from chilling, a curved copper rod extended from a point well above the chimney down into the oil, and terminated above the chimney in a small ball. The waste heat of the flame thus maintained the oil in a heated state. Eight to twenty-four of these lamps were mounted on a single armature. In Montauk Point light, twenty-four of them were used, and were removed in 1853. They originally burned sperm oil, which was afterward changed to lard oil. This lamp was fitted with a reflector illustrating the reflecting or catoptric system of lighthouse illumination.

Its successor was a French mechanical lamp for colza, sperm or lard oil, which was used in lenticular burners. In this machinery pumped the oil up to the wick, whence it continually overflowed. The machinery was objectionable and the lamp was superseded in time by Funck's hydraulic float lamp, in which the oil was carried in a reservoir surrounding the upper part of the prolongation of the chimney, thus being kept warm and fluid by the waste heat. In its course to the wick the oil passed through a chamber containing a float. The float was adjusted so as to rise and close by a valve the oil inlet as soon as the oil reached the proper height in the wick reservoir, thus maintaining the oil always at the same level. Lard oil was the fuel of this lamp. Professor Joseph Henry, who took the most active interest in the lighthouse establishment of the United States, and who was constantly experimenting in the laboratory and field upon the subjects of night and fog signals, introduced lard oil, thereby saving $100,000 per annum. The year 1864 is the date of this change. He was greatly interested in the development of the Funck lamp just described. As kerosene has improved in quality the time came, about 1873, when it naturally superseded the more expensive lard oil. For its combustion in the smaller lighthouses the lamp known as the Funck-Heap lamp was devised. This is the product of the ingenuity of Mr. Joseph Funck and Major D. P. Heap.

It is a standard Argand lamp with single wick. The feed of the wick is effected by a screw thread on the wick-carrying tube, as in the student's type of lamp. The chimney is carried in a gallery, which furnishes a support for it, and in which it can stand erect when removed from the lamp. A brass deflecting cap surrounds the wick, and around its base this cap is perforated with a number of holes. The holes admit cold air, which, forming a mantle around the flame, protects the chimney from intense heat, which would whiten or might even melt it. A deflecting button is carried by a spindle in the center of the flame. This button gets nearly red hot, and the air rising and impinging upon it becomes undoubtedly materially heated, so that a certain amount of regenerative effect ensues. This lamp is rated at fifty candle power. Its wick is 1⅛ inches internal and 1¼ inches external diameter. Its flame is so white and intense that it is almost painful to look at. It burns 1½ gills of oil per hour, 202 gallons being allowed for its annual consumption.

For the larger lights larger lamps are used. In the drawings we show the first order five-wick burner, rated at 500 candles, which is used in the first order lighthouses. Next to it is shown the first order kerosene lamp, on which such burner is mounted. This lamp is a float lamp embodying the float valve already described. To force the oil up from the reservoir below, a weighted piston is used. This piston, with leather packing, tightly fits the cylindrical oil chamber below the burner. It is weighted, and contains a valve opening downward. Its weight forces the oil up to the chamber and thence into the wick chamber. As required, the piston is drawn up by turning the handle, the downward opening valve permitting this to be done, and is then again released when its weight again comes into play, and the oil is forced upward.

In practice, the piston is raised once a night and feeds ½ gallon per hour. Its total feeding capacity is 8½ gallons. The annual supply of oil to such a burner is 2,156 gallons. In the float lamps the oil is maintained constantly at a level of 1⅛ inches below the top of the wick.

To trim the wick the valve is shut in the supply pipe, and the lamp is allowed to burn out, which it does very soon. After cooling, the wicks are then brushed off, no attempt being made to cut them. In the Funck-Heap lamp the trimming is effected also by rubbing off the wick after the oil has been burned out.

The lenticular apparatus in which these lamps are burned is universally of the Fresnel order of construction. Where the entire horizon is to be lighted, it is obvious that the lamp might be surrounded by a species of cylinder whose longitudinal section as regards each side would be lenticular. This construction would exact an immense thickness of glass for the center part. To avoid this the lens is broken up into a series of prisms, with the exception of a small portion of the center. These prisms are bent around to the shape of the lens chamber, and are so cut as to represent sections of a lens as it would be at each position of a prism. Thus immense structures are built up, the first order lenticular apparatus, which we show in one of the cuts, being large enough to contain a number of men, while the second order and fourth order lenses, which we also show in the cut, are, of course, of considerably smaller size. The smallest regular lighthouse lens used is the fifth order, and below this, for special purposes, come special lanterns; some with true Fresnel lenses, others with as near an approach to them as can be got in pressed glass.

The lenses may be disposed in annular segments, in which case their concentration of the rays of light is altogether in the vertical direction, the light, as it were, being converted from a sphere of dissemination to what is almost a disk. Sometimes flash lights are required. These are produced by having the prisms and glass of the lenses so ground and mounted as to represent a number of true lenses, which send the light out, not in discoid distribution, but in a definite number of radiating beams. If such a lenticular apparatus is rotated, it will carry with it around the circle of the horizon these beams, producing for the onlooker the effect of a corresponding number of flashes per revolution of the lens. For color effects colored glass chimneys were at one time used, but proved expensive on account of their fragility. They have been replaced by colored glass shades.

An application of the circular lens to lamps is shown in the range light, one of the largest in the world, which was one of the exhibits at the Columbian fair. As regards its refracting apparatus, the drawing speaks for itself. The back of the light is the characteristic part of the apparatus. This consists of a set of totally reflecting prisms cut at such an angle and so set as to reflect back all the light which falls upon them. Thus this range light utilizes a great part of the light which would otherwise be totally wasted. It is open at the sides, so as to give the most convenient access possible to the lamp.

In the cuts showing the first order light, the section of plate glass lantern in which the light and great lenticular apparatus is maintained are also exhibited.

To show the type of building in which these lights are placed, a view is given of Execution Rock lighthouse. This is situated on Long Island Sound, a little north of a line connecting Glen Island with Sands Point, about twenty miles from the Battery. It is one of the older structures, and in former days the keeper used to live in the lighthouse itself. Since those times a very substantial stone house has been built for his accommodation and a powerful fog signal is established to warn approaching vessels while still far from it. The light, formerly a stationary one, is now a flashing light, while the Sands Point light a mile distant is fixed.

The oil used by the Lighthouse Department must conform to the following test: It must be of 140° flash test, 154° fire test, about 0·800 sp. gr., and free from acid, and, burnt in an Argand burner of the Funck-Heap style, light must show 18 candles illuminating power on a consumption of $\frac{1}{12}$ of a gill per hour. In 1873 the use of kerosene was commenced on a small scale; its use is now universal in the United States.

The additional safeguards to navigators afforded by buoys of different classes, including electric and gas lighted buoys, also form an interesting subject. The diversity of position and surroundings and the need of absolutely distinctive characteristics for each lighthouse have given rise to much thought and ingenuity.

For small lights which are only required to be seen a few miles, the stake light or beacon is coming more into use than formerly. Our cut of a beacon shows a stake light upon the Hudson River, at Livingston Creek. Upon a crib a pole with arm is erected, and to the arm a lantern is suspended. In this type improvements have been recently inaugurated that tend to place such service on a much higher level than it has hitherto occupied. The well known tubular lamps have been used for this service. Ordinarily daily attention is required, but this can be dispensed with by the use of a supplemental oil reservoir, worked on the principle of a student's lamp. Such reservoirs holding a gallon of oil have been applied, enabling the lamp to burn for eight days without attention or extinguishment. There is also a move to substitute Fresnel lens lanterns in more important places, which would act to a degree as small lighthouses in the intensity of their light.

For shoal water stations where stake lights would be too small, trestle work is erected on the sands and on this a lighthouse station is erected. One illustration shows the Thimble Shoal Station, familiar to many visitors to Old Point Comfort. It is seen from the ships as they approach Hampton Roads. The general plan of all these stations is a platform supported by piles. Screw piles are often used. On the platform, a one-story building contains the keeper's dwelling, above whose center the light rises. They are structures favored mostly for southern waters, as they are particularly exposed to damage from floating ice. A ring of rip-rap stone work is sometimes placed around them to protect them from this danger.

In the same order comes the skeleton lighthouse proper, exemplified in Sombrero Key Lighthouse, Florida. This is a first order light, with lantern 142 feet above the surface of the water, and is rated as visible at eighteen nautical miles. There are several of this type in Florida waters resting on iron piles driven into coral rock. The details of the construction and of the care requisite in driving the piles vertically, when they were plumbed after every blow of the pile driver, indicate the difficulties of the work. It is on record that in the case of the American Shoals Lighthouse the iron work was completed at the north, was shipped, erected and the lamp was lighted at its summit in one year.

Masonry lighthouses are a more familiar and more ancient order of structure. The Minot's Ledge Lighthouse, which we illustrate, presents at high water a circular shaft rising directly out of the water, without any surrounding area. In it the keepers live, and go through the wildest storms which rage in Boston Bay. In 1847 and 1848, a lighthouse was built in this place upon wrought iron piles. Additional bracing was placed in position. In April, 1851, the whole was carried away in a storm. The last seen of it was on the night of April 16; the bell was heard a day later. This is the last known of its fate. It disappeared, leaving a few bent piles behind it. The work on the present structure began on July 1, 1855, and the difficulty of the work is shown by the fact that, in that year, but one hundred and thirty hours' work could be done on the rock. In 1860 the tower was completed. The sections illustrate the binding and interlocking of the courses of stone.

By using colored lights and flashing lights of different frequency, distinguishing characteristics are given at night. For the day, it is sometimes found useful to paint the lighthouses of distinguishing colors, so as to make them unmistakable landmarks. Cape Henry Lighthouse illustrates the use of vertical sections of color, and Morris Island Light, near Charleston, S. C., shows a lighthouse painted in broad rings or horizontal bands of color.

In connection with lighthouse stations, a view of Falkner's Island light is given, illustrating the establishment of a complete station for fog signaling as well as for light signaling. The building in the foreground not only serves as boiler house, but its roof is the water collector, and the rain supply is utilized for the boilers.

The floating structures include lightships and buoys. The lightships are strongly built schooners, which are anchored near dangerous shoals. In the daytime they are distinguished by disks at their mastheads. At night a powerful circle of lamps is hoisted up to a place immediately below the disk. They also carry a fog bell or whistle, for use as a fog signal. There are some twenty-three of these vessels on the Atlantic coast and one on Lake St. Clair. There are none on the Pacific coast. Relief lightships are kept in readiness to replace any ship which may be driven from her place. The low-placed hawse pipes leading out of the hull near the water line are characteristic. The name of the station is generally painted in large letters on the side.

The gas-lighted buoy with its reservoir of compressed gas, with high pressure regulator, burner and lenticular apparatus, illustrates a method of warning to navigators which has recently been given a formidable rival in the electric-lighted buoy. The gas-lighted buoy will burn for three months without attention. It is designed for use both as a shoal water buoy and for designating channels.

Two other types of buoys are the whistling and ringing or bell buoys. The former depend on the fact that at a sufficient depth below the surface there is no wave motion. The whistling buoy has a long tube projecting far below it so as to reach or nearly reach this depth. This causes the water within the tube to occupy approximately the same level in storm or calm. When the buoy is lifted on a wave air is drawn into it, to be expelled as it sinks again. An inlet for air connects with the top of the tube and an outlet tube surmounted by a whistle also connects thereto. Otherwise it is tightly closed. When a sea is running a constant series of low-pitched whistling signals is thus produced.

The bell buoy of the type illustrated carries a fixed bell, with three nearly horizontal tubes arranged radially around its perimeter. Each contains a ball. With the least inclination one or the other ball rolls down its tube and strikes the bell. In very slight waves a constant ringing is thus kept up.

In our cut of the whistling buoy is shown the use of a fixed rudder plate to avoid danger of entanglement or fouling with the chain. This plate, acted on by the tide, keeps the buoy constantly facing toward its moorings. Without it there would be danger of the chain winding around the long tube. For the bell buoy the use of a bridle or double attachment of the chain is shown. The weight hung at its bottom for ballast is also shown.

The electric-lighted buoy now in use in the harbor of New York is also shown in the cut. It is used to define Gedney's Channel, so that ships can now enter by day or night. The buoys are fifty-foot juniper logs, each surmounted by the lamp shown in the cut, contained in a protecting iron cage. The lamp, of incandescent type, is rated at 100 candle power, with three loops in its filament to give even distribution. The lantern can be lifted out bodily from the frame or the lamp alone can be removed if desired. There are three buoys on each side of the channel, about 2,000 feet apart. The station is situated at Sandy Hook. The plant is of the Edison type. The dynamo gives a direct current of 25·5 amperes and maintains a potential difference at its terminals of 100 volts. We show the construction of the heavy cable which it has been found advisable to use. The whole installation is cited as the only one of the kind in the world. By its use a channel 1,000 feet wide and 4,000 feet long is defined as clearly at night as by day.

We also illustrate the statue of Liberty in New York Harbor. The statue now carries in the torch a powerful system of electric lights. It has been proposed to so modify the distribution of light that the direct view of the light will be had from a distance only, while vessels near it will be protected from its glare. By reflectors the body of the statue proper will be lighted.

Our thanks are due for courtesies received to Commander C. H. West and Major D. P. Heap, of the United States Lighthouse establishment.

In connection with this subject we quote the following from a recent number of Engineering:

"The entrance to New York Harbor lies between what is known as the False Hook, which runs out from the low sand dune called Sandy Hook, and the two dangerous shoals which skirt the southern end of Long Island, known as Romer's Shoal and Flynn's Knoll. From the ocean, vessels enter the narrow Gedney Channel, wherein many a good ship has been stuck fast to wait for the rising tide, and proceed into the broader main channel west by south, and then almost due north, through the Staten Island narrows into the harbor itself (Fig. 1).

"The importance of a safe entrance and exit for the immense ocean-going traffic of New York City, which is the distributing center for the east, north, and northwestern parts of the United States, cannot be overestimated. It was the realization of the importance of this fact that impelled the Lighthouse Board to give especial attention to the buoyage of the largest port in the States. The work recently completed shows that a great step in this direction has already been made, and the entrance to New York Harbor—at least that most important part of it, the Gedney Channel—is now as well lighted as a city street, and almost as safe. And this work is by no means so extensive as is at present contemplated; further improvements and additions are now being devised, to be realized as soon as time will allow.

"The illumination of the Gedney Channel is now effected by means of buoys, carrying an incandescent

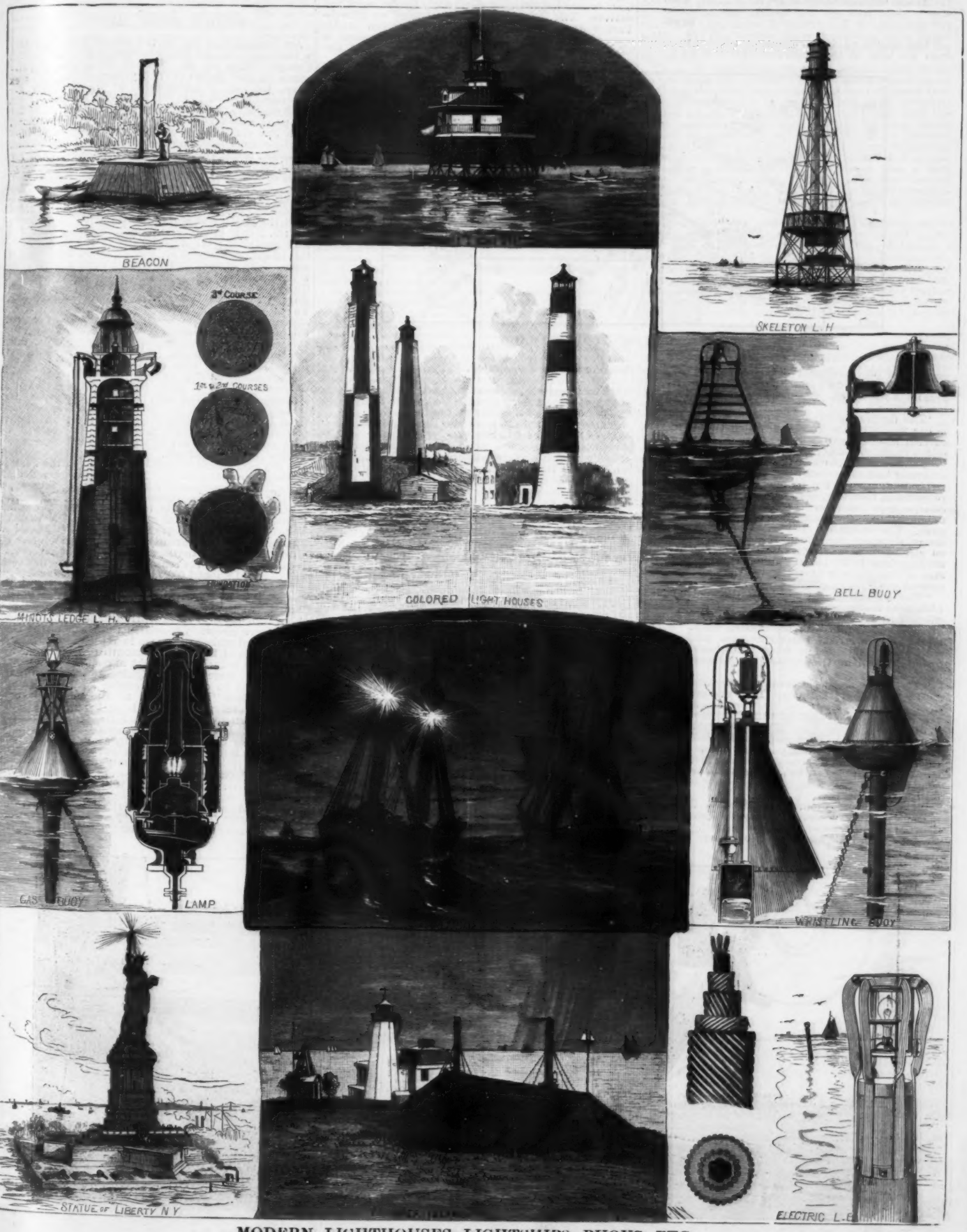
lamp, lighted by means of an alternating current generator at Sandy Hook, and transmitted thence, under water, to the buoys. These are mast buoys, each mast being between 60 ft. and 70 ft. in length. They are anchored to the bottom by means of hollow mushroom-shaped pieces of cast iron, weighing about 5,000 lb., which act as sinkers upon the sand, and protrude from the water like the weather-beaten masts of some wrecked ship. They are ranged along each side of the channel as are lamp posts in the streets (see Figs. 2 and 3).

"The lighting station is situated almost at the extremity of Sandy Hook. To the equipment installed to light up the experimental buoys, two 9 kilowatt multipolar generators have been added. These are arranged with both commutator and collector rings, to permit of the delivery of both alternating and continuous current at the same time. The alternating current is required for the illumination of the buoys of the Gedney Channel, and to light the lamp in the Hook Beacon, a lighthouse at the extremity of Sandy Hook. The continuous current is now used to light the buoy on the southwest spit which forms the south corner of Flynn's Knoll. The alternating current has a frequency of 40 cycles per second, the generator revolving at 1,200 revolutions per minute. These machines are of the latest type, having cast steel fields and armatures with removable coils. One only is in use at one time, the other being held in reserve.

"The lighting of the buoys in the Gedney Channel is effected on the series system, the voltage in the primary circuit being 1,000 volts, which is reduced at the lamps to 100 volts. That of the continuous current is 150 volts.

"The switchboard in the station is of white marble, and carries all the instruments in duplicate. The necessity of having all the machinery in duplicate can readily be understood, the consequence of a breakdown in case of one set only being in use being easily imaginable.

"From the dynamo station at Sandy Hook two underground land wires are laid to the landing place of the Gedney cable at the north end of the Hook, and branch wires are tapped from it to the lamp in the Hook Beacon. Two other wires are laid from the station to the landing place of the cable leading to the buoy on the southwest spit. In both these circuits one of the wires is lead covered, over rubber insula-



MODERN LIGHTHOUSES, LIGHTSHIPS, BUOYS, ETC.

tion, the other being bare, and both are laid underground in a substantial conduit of creosoted wood.

"The distances of the buoys from the land near the Hook Beacon are shown by the length of cable required.

	Feet.
Hook Beacon to Buoy No. 1	10,860
Buoy B 1 to Buoy G 7	2,700
" G 7 " G 5	2,200
" G 5 " G 3	2,200
" G 3 " G 1	2,200
" G 1 " G 2	1,000
" G 2 " G 4	2,200
" G 4 " G 6	2,200
" G 6 " G 8	2,200
" G 8 " B 2	3,300
Actual cable on buoys at 100 ft.	1,000
	32,060

"The length of the subaqueous cable extending from the land to the southwest spit is 10.214 ft.; it consists of one conductor of seven copper stranded wires of No. 18 Brown and Sharpe gage, and has two armors of steel wire. It weighs about 19,113 lb. to the statute mile.

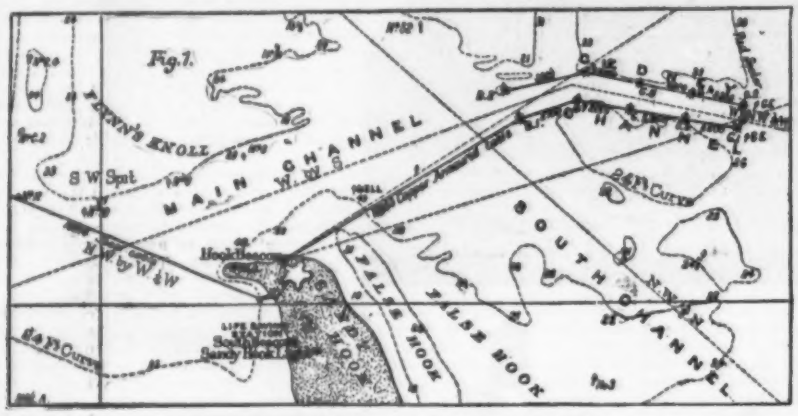
"The lighting of the buoys of the Gedney Channel is the first instance known in which the alternating current has been used for this purpose. The cable is of the single conductor single armor type.

"In the manufacture of this cable the use of iron as an armor had to be discarded, as with it the effects of self-induction were too pronounced. The armor employed has, therefore, been made of No. 18 Brown and Sharpe gage hard-drawn copper wires: the conductor consisting of seven stranded copper wires of similar gage. The insulation between the conductor and armor, by which the current returns, is of well seasoned gutta-percha, having a resistance of not less than 300 megohms to the statute mile. The exterior diameter of this cable is about ¾ in., that of the direct-current cable 1⅝ in.

"The conversion of the alternating current from 1,000 volts in the primary to 100 volts for the lamp is effected in a small transformer of 600 watts capacity fitted inside the head of the wooden buoy. Each is mounted in a strong watertight case, which, as an additional insulation, is filled with heavy oil. All openings into the transformer are, of course, watertight.

"The lamps are of 100 candle power each, and are set at the top of the buoy. They are protected by heavy bell glass globes, and the iron cage used on the experimental buoys is discarded. The lamps are 5 in. in diameter, and the filament is spiral in shape. Each lamp takes from 3½ to 4 amperes of current. In the Hook Beacon a similar lamp is used, and is so fitted in the lens that it can be removed and another substituted at once in case of accident. A small transformer, similar to those used in the buoy heads, is also used for the Hook Beacon.

"The cables were laid by the Western Union Telegraph Company, accompanied by the lighthouse tenders of the Inspector of the Third District, from which the buoys were laid and connections made."



ENTRANCE TO NEW YORK HARBOR.

COAL MINING IN THE TRANSVAAL, SOUTH AFRICA.

THE South African Mining Journal gives the following account of the mines of the Transvaal Coal Trust, located sixteen miles east from Johannesburg. The mine is developed by the "old" and "new" main shafts. The old main shaft is no longer used for development purposes, but the pumping and electrical plant is placed there, and the workings are drained to a large reservoir excavated in the neighborhood of the shaft. This has a capacity of about 1,000,000 gal. The mine makes about 85,000 gal. a day. A Cameron steam pump, with a capacity of 24,000 gal. per hour, is in use and can easily cope with the water made, even in wet seasons. An Evans' Cornish pump of 16,000 gal. is kept in reserve, and a Tangye pump of 3,000 gal. per hour is used for pumping clean water for the use of the natives. The lighting plant consists of an Ellwell-Parker dynamo with fifty lamps of sixteen candle power, and a small Tangye engine. The new shaft is placed close to the line of railway, with which the loading floors are connected. The shaft is 13 ft. by 9 ft., with two hoisting ways and a pump way, each 4 ft. by 9 ft. Cages carry two 20 cu. ft. trucks, equal to about 18 cwt. of merchantable coal. The shaft is 131 ft. deep (156 ft. to the delivery platform).

The present output from the shaft is 1,000 tons a shift of ten hours, but this can be increased to 1,500 tons without any extra pressure upon the facilities. The hoisting is done by a coupled 15 by 20 Daglish engine, with 8 ft. 6 in. drums. The delivery platform on the headgear is very large, being 75 ft. by 50 ft. To obtain the necessary fall to the screen it has been built 25 ft. above the ground and its timbers covered with a flooring of sheet iron.

The steam for the surface engines and that under ground is drawn from three Babcock & Wilcox boilers. The water used is very impure, owing to the sulphides in the coals. Magnesia and lime compounds are also present.

The coal bed is practically horizontal, 12 ft. to 14 ft. thick. The roads are 10 ft. wide and 7 ft. or 9 ft. high, and lighted by electricity. Endless cables are in use in some of the roads, and this system will soon be much extended. The principal road has a cable for 1,800 ft., with a cable of 900 ft. at right angles driven off it by means of double pulleys. In the side roads mules are employed. The mining is all done by natives under the superintendence of Europeans.

The usual pillar and stall system has been adopted, the pillars being about one-fourth of the total quantity developed. An excellent roof of shale is found almost throughout. Only three boys have been killed during the last two years. The coal is almost free from shale bands and it is the practice to mine everything and sort out the small proportion of shale at the belts. The deposit differs from European fields in the absence of cleavage lines. This has the effect of making the mining costs higher, for the coal appears as a solid and unbroken mass and no advantage can be taken of the usual natural divisions. The probable recent character of the deposit and the absence of any weight of superincumbent rocks and corresponding pressure are doubtless the reasons for this absence of cleavage.

Dynamite is used. The drilling is all done by native miners, but Mr. Williams declares in favor of coal cutters, preferring the percussive type driven by compressed air as being lighter and more easily handled. The cheap labor of the native miner has assisted to prevent their adoption, but it is the question of initial cost which is the principal objection urged against them.

The total quantity of the clean coal, round and nut, produced to date is 859,459 tons; the proportion of waste has not been less than 20 per cent., and 25 per cent. of the total quantity developed is still in the pillars. The monthly tonnage is increasing, and the output of this year will probably considerably exceed 300,000 tons.

PUMICE STONE MINING.

AN interesting report on the pumice stone industry in the Lipari Islands has been furnished to the British Foreign Office by Mr. Norman Douglass. Pumice occurs on most shores of the Tyrrhenian Sea and elsewhere, but that of commerce is at present almost exclusively obtained from the island of Lipari. It is a trachytic lava, rendered light and scoriaceous by the escape of gases, and every gradation can be traced, from this condition to the heavy vitreous matter of similar composition, known as obsidian. Good pumice contains: Silica, 73·70 per cent.; alumina, 12·27 per cent.; potash, 4·73 per cent.; soda, 4·52 per cent.; oxide of iron, 2·31 per cent.; water, lime, etc., 2·47 per cent.

Most of the volcanoes of Lipari have ejected pumaceous rocks at some period or other, but the best stone is all the product of Monte Chirica, with its accessory craters, Monte Pelato and Forgia Vecchia. The district containing the deposits lies in the northeast of the island, and covers an area of about three square miles. The mineral is excavated in various parts of it; in the plateau of Castagna, on the sides of Monte Chirica and Monte Pelato, at Perera, near the seashore of Acqua Calda, and at one or two isolated points. To this end tunnels or galleries are dug into the lavers of denuded lapilli and ashes that have gradually covered the pumice. The mineral is sometimes found near the surface, at other times under a layer of white tufa. Digging is not difficult. The tunnels are lighted at intervals by small terra-cotta lamps of antique form, and are so narrow that two men can barely pass. The deficiency of air is soon felt. Sometimes, when a stratum of pumice has been reached, crosscuts are run to gain a larger supply of pumice out of the soft material in which it lies embedded. It is often a matter of speculation how soon pumice will be reached, so that many tunnels are abandoned while others are worked for long periods. The output may be large one day and almost exhausted the next, or the quality of the stone may change. It has been observed that certain localities produce certain qualities; thus, some of the best pumice comes from Acqua Calda and Monte Pelato, while the inferior variety, known as "alessandrina," is found at Castagna. The number of tunnels actually in working has been estimated at 250, but they vary greatly in size. The number of workmen also fluctuates according to their personal requirements and the season of the year, but has been estimated at about 1,000, of whom 600 are miners.

Pumice is brought to the surface in large blocks or in baskets, and is carried to the village of Canneto by land or to the seashore, to be taken there in boats. About one-fourth subsequently reaches Lipari by sea. It is there generally stored in the sheds of the merchants, and unless these are in a hurry to dispose of their stock, it is allowed a month to get thoroughly dry. This reduces the weight and shows the quality. After that, large blocks weighing 15 lb. and upward are allowed to crumble according to their cleavage into so-called "lisconi," and all the pumice is then sorted according to its size into (1) large ("grosse," lumps down to the size of a fist); (2) medium ("correnti"); and (3) small ("pezzame," from 2 in. downward). The quality is primarily a matter of texture. As pumice is used for polishing purposes, an essential condition is homogeneity of structure and freedom from included crystals. The stone must be neither too brittle nor too hard, and it is in these respects that the Lipari pumice surpasses that of other volcanic regions. After it has been divided according to its size, the large stones ("grosse") are again sorted into three superior qualities called "flore," "quasi-flore,"

FIG. 2.

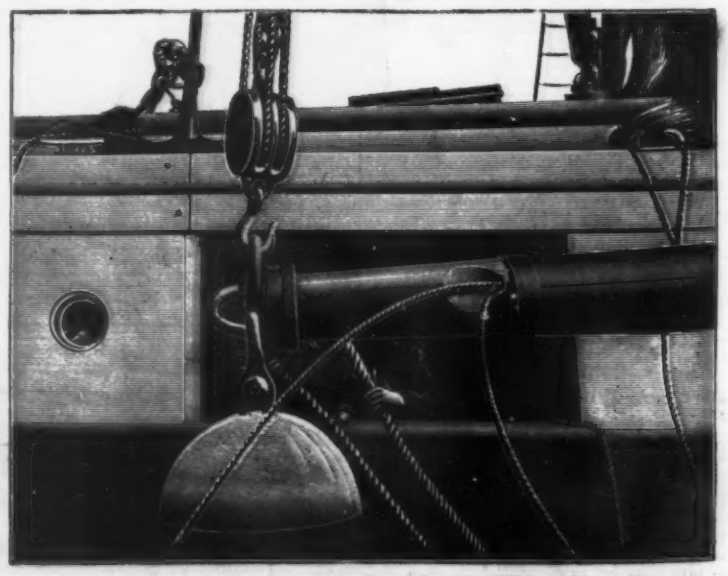


FIG. 3.

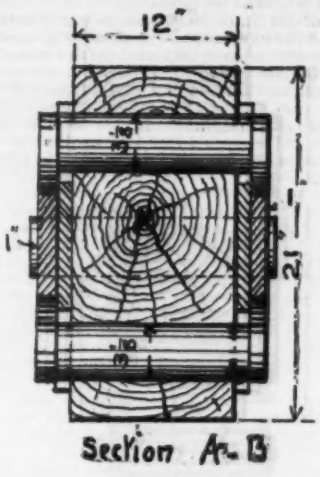
ELECTRIC BUOYS—NEW YORK HARBOR.

and "mordente." These are never filed. After they have been selected, the remainder of the "grosse" are filed by hand in order to remove asperities of surface and to see whether the stone is not too friable for use. They are then reclassified into first, second, and third ("bianche," "dubbiose," and "nere"). Large pieces of inferior pumice, known as "rotonde," are never trimmed. Besides this there is an entirely different variety called "alessandrina," which is cut with hatchets into brick-shaped pieces and used for smoothing oil cloth, and a heavy, dark stone, "bastardone" (always trimmed), as well as many less important varieties. The "correnti," commercially termed "sorts," contain all varieties, and are generally exported as they are; the "pezzame" is usually, but not always, ground down to a powder of more than ten different degrees of fineness, according to the work for which it is required.

So extensive are the deposits that the supply is practically inexhaustible. The pumice washed up by the sea is hardly ever collected nowadays. The number of tunnels could be increased indefinitely, and if they were worked on a larger and more systematic scale, the output would probably be trebled. Thus the superior material which is now obtained, not without danger to life, by running tunnels into the precipitous internal crater wall of Monte Pelato, could be reached by longer tunneling from the outside, where there are only a few caves at present. The only menace to the pumice industry lies in the introduction of artificial polishing materials.

SPLICE FOR REINFORCING LARGE STICKS OF TIMBER.

THE accompanying illustration shows a new form of clamp that is being used in splicing the leaves of the bottom chords of Howe truss railroad bridges in the West. It was designed by Mr. W. H. Grondahl, the resident engineer of the lines of the Southern Pacific Company in Oregon. The company have lately been putting up some new timber and iron bridges of exceptional length; and the increased size of the sticks of timber used in the bottom chords necessitated a more satisfactory form of clamp for securing the abutting ends of the sticks than the ordinary cast iron clamps hitherto in use. In the clamp herewith shown four turned pins three and one-eighth inches in diameter are driven snugly into holes bored to receive them near the end of each stick. Two cast iron bearing plates are fitted closely against the stick, one on each side of it, and they have recesses, a, a^1, a^2, a^3, turned in their edges, which engage snugly the ends of the pins where they project from the sides of the chord stick. An eye-bar, of the form used in steel bridge construction, is secured on the outsides of these plates, and the eyes at each end engage the two extreme pins which project far enough beyond the plates for this purpose. One end of the eye bar is furnished with a small eccentric, by means of which the abutting timbers are drawn



eye-bar increased, until the joint is as strong as the uncut body of the timber.

A timber bridge of the unprecedented length of 250 feet, whose bottom chord was spliced with this form of clamp, was recently tested with a loaded gravel train and showed only half an inch deflection.

[FROM THE WHEEL.]

THE NICKEL PLATING OF BICYCLES.

NO other part of bicycle work demands more thorough and careful attention than the plating. Due consideration is given to this by all experienced manufacturers, and its importance cannot be overestimated, as it is well known that a poorly plated wheel soon becomes an object of neglect.

In the early days of bicycle manufacturing the plating was not deemed worthy of special effort, and, as a rule, was intrusted to the nearest jobbing shop; but, with improvements in general construction, the necessity of a better grade of plating became apparent. Frequent complaints were received by dealers that the nickeling was poor; it would peel off or rust, and the manufacturer was obliged to go to the expense of doing the work all over.

The improved facilities for doing this work and the demand for a better grade of plating soon brought manufacturers to the point of getting their own outfit for this important branch, and now it is a rare occurrence to find a bicycle shop so small that it can get along without a plating plant. It may be true that a man is not judged by his clothes, but the appearance of a modern tricycle determines, to a great extent, the class to which it belongs. Manufacturers are well aware that an inexperienced buyer will often question the merits of an otherwise strictly high-grade wheel that seems imperfectly plated and favor some other make that presents a better and more showy appearance.

ATTENTION TO POLISHING AND CLEANING.

The highest grade of nickel plating can only be secured by giving fully as much attention to the details of polishing and cleaning as to the plating itself. It is of the first importance, therefore, that the surface of work to be plated is made perfectly smooth and free from all scratches. Until a comparatively recent time, it was considered impossible to erase all signs of emery scratches from steel surfaces, and a good luster was all that was thought essential, but this feature has been overcome and the present rule for high grade work calls for a surface with as fine a finish as burnished brass. The methods employed to produce a fine finish on bicycle work are not of a varied nature. It is true that all experienced polishers have certain rules and ideas with regard to the polishing wheels used, and no two men are a unit on this point.

POLISHING.

The first process, called "roughing out," is usually done on a glued canvas wheel, or a leather-covered wood wheel, or a bull neck wheel. The wood wheel, however, seems to be gradually falling into disuse. It is claimed for the canvas and the bull neck wheels that they have more flexibility and do not gouge the work. For the various parts depending upon shape and size, wheels adapted to the surfaces presented are employed.

Thus, on handlebars, parts of crank, brake lever, and work of this nature, a cheap canvas wheel can be used for roughing out, while cones and surfaces that are grooved should be done on bull neck or walrus leather wheels, continuing to use this grade with the finest number of emery until the final finishing, which should be done with felt wheels. On these primary wheels must be used Nos. 60 and 90 emery, depending upon condition of surface to begin with. The second operation is similar to the first, except that a finer grade of emery is used. This is called the "second roughing," and should remove all the coarse scratches left by the first wheels. Emery varying from 90 to 120 is used.

The third wheels used are the most carefully selected and expensive of all. This process is called "greasing," and can only be done on a wheel combining a smooth surface with flexibility. There is nothing better for this operation than a walrus wheel, and many concede it to be superior to the best grades of felt, but, owing to the difficulty of getting walrus leather more than an inch thick, it is not used to such an extent as it otherwise would be, and its place is taken by hard felt.

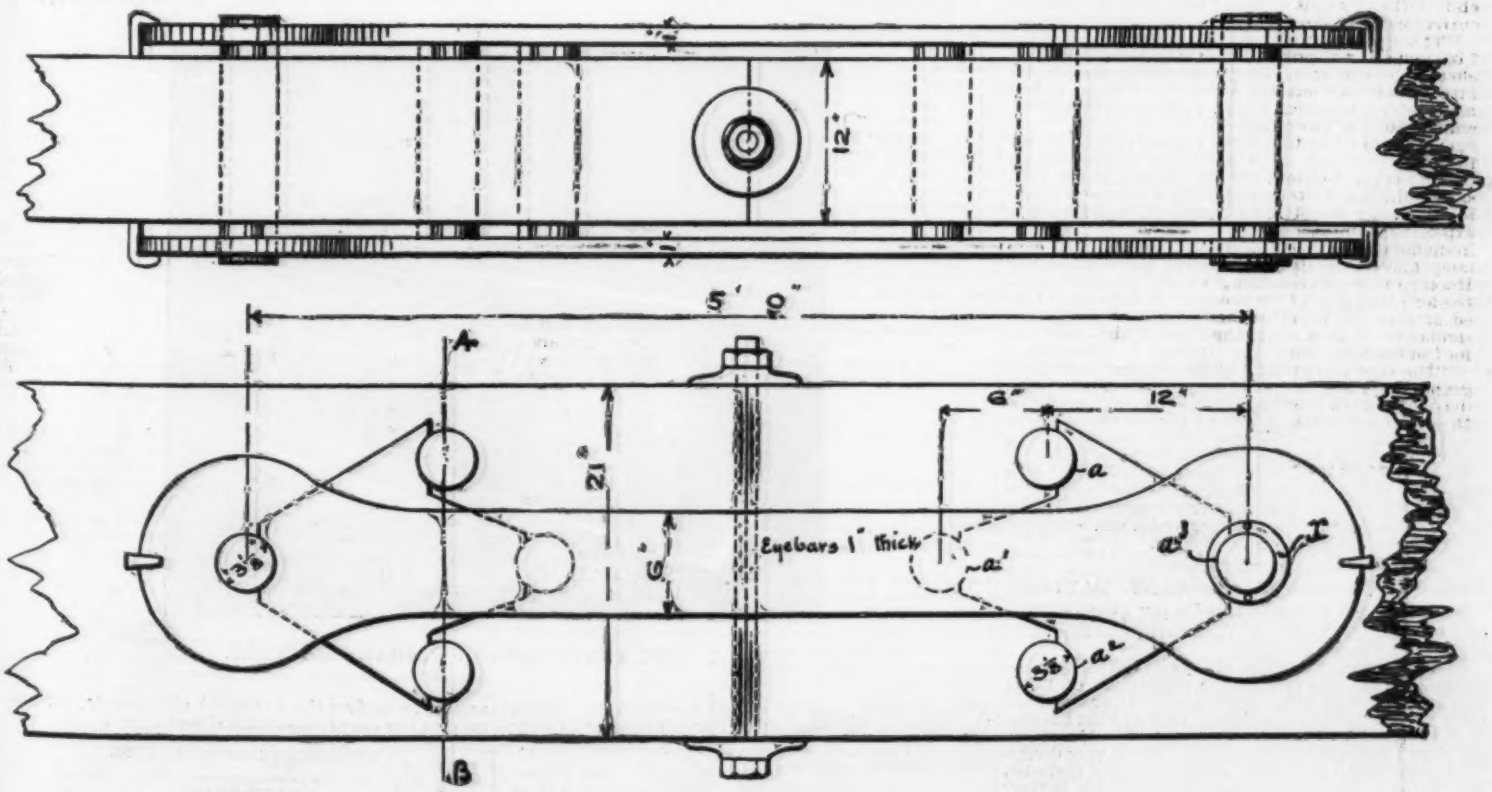
Every shop has its assortment of fine felt wheels, and it is not thought economical to use any but the best obtainable, as a cheap wheel gives endless trouble by being hard to balance, in consequence of the liability of one side being slightly heavier than the other. The best wheels are of a more uniform consistency, and, notwithstanding the high speed at which they are run, are much easier kept in balance. The finest grade of emery must be used on the "grease" wheel, as this is the last polish the work receives, with the exception of the coloring wheel, before it is ready for the plating room. It is sometimes thought an advantage to use a tampico wheel for a finishing touch, to take out any semblance of scratches that may still appear on the object.

Sometimes an intermediate wheel is required between the second roughing and final greasing, but with good material and a careful polisher this would be superfluous, and the three operations described should be sufficient.

COLORING.

The operation of "coloring" is done with the same

Splice for large Timber



class of wheels as the "greasing." This wheel is set up with flour emery and worked down with a hard flint stone. If the polish is dim, a little crocus and oil should be used before applying the stone. The coloring before plating causes the finished work to buff up with a brightness impossible to secure otherwise, and makes it possible to bring up a good color on nickel after exposure to the elements.

All work leaves the polishing room greasy, and as grease is the deadly foe of nickel, every trace must be removed before any attempt is made to plate the article. Therefore, upon reaching the plating room the work is first put in a strong solution of hot XXX lye and allowed to remain there until all grease and foreign matter are boiled out. By the side of the lye kettle is always placed the hot water kettle, in order to take advantage of the steam connections.

The scrubbing sink should be in close proximity to the XXX lye and hot water kettles, and in any case should not be removed more than a few feet. After leaving the hot solution of XXX lye, the object is scrubbed with pumice stone in the scrubbing sink, which is always supplied with running water and an abundance of it. This operation is supposed to remove the last trace of grease, but so imperative is the necessity of removing all suspicion of foreign matter, that some of the work, such as chains, pedals and small parts, are immersed before this scrubbing process in a diluted sulphuric or muriatic acid dip.

Before hanging in plating solution the work is washed through the cold water again, and if perfectly clean and free from grease, the water will cling to the polished steel. If water does not adhere to the work, it indicates the presence of grease still, and the process must be repeated. When work is ready for the plating tank, it should be immediately immersed in the solution, for it must be remembered that the moment the object leaves the scrubber's hand corrosion begins as soon as it is exposed to the atmosphere, and means should be taken to reduce this exposure to a minimum. Failure to observe this is responsible for much of the difficulty for which no tangible reason can be found. A plater will insist that all attention has been given to detail, and an oversight of this kind, not being valued at its true significance, is overlooked, and he vainly looks for a remedy. Often this is the cause of so much rust showing through in small spots, giving the appearance of scaling from beneath the surface, indicating that corrosion began before deposition had taken place. Similar signs appear when work has not been properly cleaned or treated.

COPPERING.

All manufacturers now concede that work should be coppered before nickeling, and while there are many methods of copper plating, there is only one way to treat bicycle work to obtain the best results. A "strike" solution is of no special advantage, and will not materially improve the plating, except to enable the operator to observe more readily any defect in cleaning. A somewhat heavier deposit that will not stand buffing is hardly any better, for, unless great care is taken in scrubbing, the nickel will peel off in spots, often taking copper with it. This method requires a heavy coat of nickel, and a good luster cannot be obtained by the buffer until considerable of the nickel is buffed off.

The process in vogue by all high grade bicycle platers, and which has been attended with the best results, is secured by depositing a good heavy coat of copper, so that it may admit of being buffed bright without the steel showing through, and recleaned with lime or whiting and soft bristle brush. By adopting this method of coppering the work, with a moderate current from the dynamo, it can hang from one to three hours in the nickel bath, plating slowly, and when buffed up will show a beautiful luster, without buffing off or destroying any of the nickel.

The method of handling the copper plating is not difficult, but requires close attention and a solution built up to suit the work. If the copper solution is in good condition and the current right, a sufficient thickness of copper should be deposited in from fifteen to twenty-five minutes.

The final deposition of nickel requires as much care as skill, and the details of preparing and cleaning the work are of more importance to the general results than any other part of the process. It is thought best by experts in this work to allow nickel to deposit slowly, from one to three hours, and have thorough control of the current from the dynamo by means of a switchboard on every tank. In distributing the switchboards in this way the tank may be filled with work or have only a few small pieces, and by cutting off current at the switchboard, or by a turn in the opposite direction, the full force can be thrown on, thus using the current as the work in the tank requires.

When the work has been successfully plated it is sometimes neglected in buffing. The best method is to cut down on loose buffs and crocus and finish on a soft wheel and best nickel rouge, which will bring out an extremely beautiful luster or color.

THE VELVO-CARBON PRIMARY BATTERY.

SOME time ago we described in detail a primary battery brought out by Mr. H. T. Barnett, and named by him the velvo-carbon battery.

Zinc must, in our opinion, always be too expensive a material to use as a fuel for the production of, let us say, even one-half horse power hour. It was claimed for a certain two-fluid primary battery that the cost of the materials used was at the rate of half a crown per Board of Trade unit produced, but it is very doubtful whether even that price would cover the real cost. Mr. Barnett, however, claims that with his battery the cost for materials used can be kept down to this figure. We will now describe the improved form of the battery, which is shown in Fig. 1, and consists of twenty glass cells, each 12 in. long by 4 in. wide by 12 in. deep. These are shown standing in a lead-lined tray, and the floor space occupied was about 8 ft. by 3 ft. The element consists of carbon and zinc in an electrolyte of dilute sulphuric acid of a specific gravity 1140.

The carbons are arranged in palisade form, as previously described, and one of the complete palisades is shown in Fig. 2. A wooden top bar 2 ft. long serves as a support for two sets of sixteen hollow arc light carbons, 9 mm. diameter. Each carbon is 10 in. long over all, and is connected to the top and bottom strips of wood by being fixed into holes with Griffiths' anti-sulphuric enamel; the whole of the surface of the wood is also treated with the preparation.

A length of 8¼ in. of each carbon rod is exposed to the action of the electrolyte. A silver wire is attached to the upper end of each rod, and all the wires are soldered to a common connecting bar of silver-plated antimonial lead, which runs the whole length of the top bar.

A zinc plate is placed at each side of the palisade, and the two plates are held in position by a screw and wing nuts seen in Fig. 2. All the zinc plates are

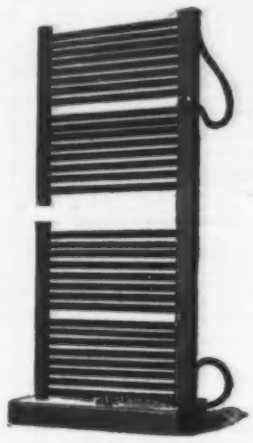


FIG. 2.

thoroughly amalgamated before use. The connection between the cells is made by means of loosely laid stranded copper cable inclosed in India rubber tubing. The wing nuts and screws are made of silver-plated antimonial lead, in order to avoid the incipient welding action which takes place when pure lead nuts are used on pure lead screws.

The top cross rods of the palisades are supported by a strong wooden bar running the whole length of the battery and supported upon the glass cells. Each cross bar is fixed at its center into the common bar by means of wedges It is thus easy to dismount any one particular palisade. The cells are filled with electrolyte by means of a stopcock and India rubber pipe, and each glass vessel is provided near the bottom with an outlet closed by a stopper. A differential block and tackle are so arranged that the whole of the zinc and carbon pairs can be drawn up out of the cells, or these can be let down to any required depth.

Forty cells are usually supplied as a full set, and these give about 24 volts. The capacity is stated to be 800 ampere hours with one charge of acid. Eight 10-candle power Edison-Swan lamps were being fed from the battery at the time of our visit. The zinc used is No. 16 gage, made in Belgium, at Vieille Montagne, and marked V. M. . . .

The makers, the Battery and Motor Company, of 53 Victoria Street, propose to sell the batteries without zinc through the trade, and to supply the zinc to customers direct, at 5d. per lb., properly amalgamated.—The Engineer, London.

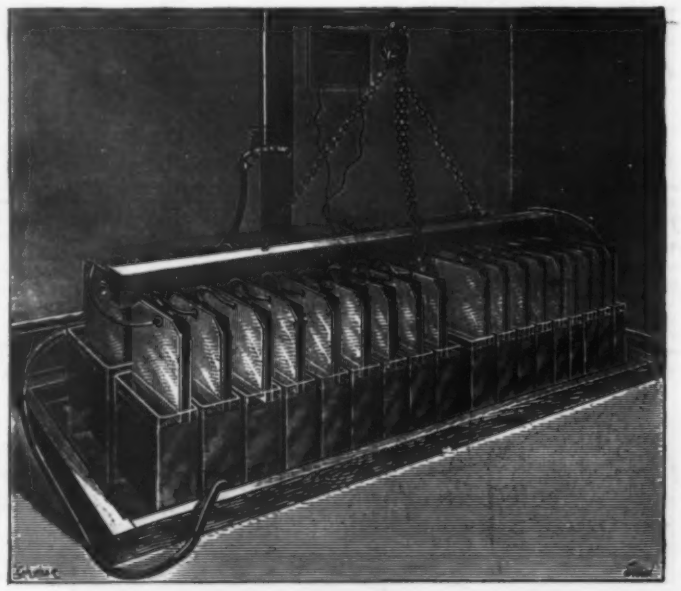


FIG. 1.—THE VELVO-CARBON PRIMARY BATTERY.

NICKEL STEEL AND ITS ADVANTAGES OVER ORDINARY STEEL.*

By HENRY A. WIGGIN, Birmingham.

BEFORE reading the paper that I have undertaken to do, on nickel steel, I should wish to explain that my knowledge of steel making is limited, and that I do not desire in any way to enter into the question as to the advisability or not of the use of nickel steel. I merely want to bring before the notice of the members of the institute some facts as to the uses of this material, feeling sure it will interest many attending this meeting to know what is now being done in other countries with this remarkable alloy. I am indebted for much valuable information to Mr. Thompson, president of the Oxford Copper Company, in America, and to Messrs. Lander and Larssen, of Birmingham, the agents of the Bofors Steel and Ordnance Works, in Sweden, whose managing director, Mr. J. C. Kjellberg, has favored me with some interesting statistics.

The use of steel in place of wrought iron for structural work, shipbuilding, rails, and other purposes, including armor and forgings for guns, met with an earnest and long-continued opposition. Steel, while stronger and stiffer, was said to be untrustworthy, and it made its way but slowly. The old, well-tried wrought iron was considered safer, although it required a greater section and weight than was required with steel. With the improvements in the manufacture of mild steel, greater uniformity was obtained in the product, and this reproach no longer existed. Now, it is unnecessary to remark, wrought iron has become almost a thing of the past for structural and other purposes, as steel of less section and weight gives the same strength and stiffness, with as great an elongation and safety. It is not necessary to state these admitted and well known facts to the institute, except for the purpose of recalling the reasons which led to the use of steel in the place of wrought iron, and to see whether these reasons cannot now be advanced with the same force for the use of a better material than ordinary steel. Nickel steel, containing about 3½ per cent. of nickel, is now being produced with the same elongation, a tensile strength fully 30 per cent. higher than ordinary steel, and elastic limit at least 75 per cent. higher. This material, although comparatively a new article of manufacture, possesses great uniformity, the nickel being uniformly distributed throughout the ingot, and is not liable to segregation like other of the ingredients of the steel.

For building and structural material the greater strength of nickel steel, and particularly its high elastic limit, make it far more advantageous than ordinary steel. It is the elastic limit that governs the section in this material. The elastic limit of the nickel steel is nearly double that of ordinary steel, while beyond the elastic limit there is a considerable range to the ultimate strength, with a large elongation. The use of nickel steel in beams, channels, bulb angles, etc., would, no doubt, lead to a change in the form of section, similar to that which was made when steel superseded wrought iron. In the case of the steel frame of a large building or other structure, the weight of the frame itself is a considerable part of the load, and any saving in the weight is a great gain.

New boilers for the United States cruiser Chicago are being made of nickel steel, which will give the necessary experience to determine what degree of advantage there may be in the use of this material for this purpose. Corrosion experiments have been made with specimens of nickel steel, in competition with specimens of other kinds of steel, under conditions which would indicate its adaptability for use in boilers, and for the under-water hull plates of vessels. These experiments, while on a small scale, and consequently not conclusive, seem, however, to show for these purposes nickel steel possesses a marked advantage in being less corrodible. This is also confirmed by the experience obtained from the use of nickel steel propellers. The following results, giving the relative loss by corrosion of nickel and other steels under different circumstances, are taken from the results of some experiments, and appear to confirm the statement above made, with regard to the use of this material for boilers:

PERCENTAGE OF TOTAL LOSS.

Kind of material.	Solvents. — Ten per ct. salt water boiling for three months.	Steam for two months.
Nickel steel.....	1·00	0·27
Bessemer steel. ...	1·81	0·58
Open hearth steel .	1·97	0 31
Open hearth steel..	2·00	0·36

Test pieces were 1 in. by 1 in. by ⅛ in., polished on all sides, and weighing approximately 1 oz. The boiling water test was made in a flask placed in stone bath, and kept almost at a boiling temperature, pure water being added to replace the water lost by evaporation. The steam test was made with steam at atmospheric

* Iron and Steel Institute, August, 1895.

pressure. The test pieces, after being exposed to the solvent, were carefully cleansed with a brush, washed with alcohol and ether, dried and weighed.

Experiments for flanging nickel steel plates of all thicknesses suitable for boilers show that this material is worked without any difficulty. It can be readily forged or pressed in dies without cracking, its large elongation enables it to be worked to great advantage. If the allowed pressure in a boiler is proportional to the ultimate strength of the material, a boiler of nickel steel would carry a pressure 30 per cent. higher than one of ordinary steel of the same weight; and if the corrosion experiments above referred to are confirmed by experience, the nickel steel boiler will have a decidedly longer life.

If the relative elastic limits of the two materials are considered, this allowed boiler pressure would be still greater. With the use of high pressure steam for compound engines this ability to increase safely the boiler pressure makes nickel steel a very valuable boiler material. Not only for this purpose, but for all structural purposes, the high elastic limit of nickel steel is a peculiarly valuable feature, as the load is calculated for the elastic strength of the structures, not the ultimate strength. When the rule for the safe load is given in terms of the ultimate strength, it is merely for convenience, as the ultimate strength is always determined from the tensile specimens, while the elastic limit is not always given. With ordinary mild steel the elastic limit is considered as one-half the ultimate strength, with nickel steel in the form of structural material it is about three-fourths of the ultimate strength. If you could get an ordinary steel having as high an elastic limit as that of nickel steel, it would be a higher carbon steel, very deficient in elongation, and which could not be worked to any advantage, and which would not be considered suitable or safe. Nickel steel beyond the elastic limit has a sufficient range of increased resistance with fully as large an ultimate elongation as the much weaker mild ordinary steel.

The high limits of nickel steel, together with its large elongation, and particularly its high elastic limit, would indicate that this material would also be well suited for gun forgings. It is being tried for this purpose with every prospect of success. That nickel steel, giving when tested the ultimate strength, elastic limit, and elongation claimed for it in this article, can be produced with uniformity, is too well known to need here a list of the results of tensile tests. Under the drop test nickel steel gives better results than ordinary steel, even in a greater ratio than exists between the results of the tensile tests of these two materials. This is also found in the toughness imparted to armor plate by the introduction of nickel. The ability to resist shock without fracture is not altogether a question of elongation. A built-up column of ordinary steel may break across in falling under its own weight, the fracture showing but little appearance of elongation, yet tensile specimens taken from this material close up to the fracture will show the required elongation, 15 per cent. or 20 per cent. Nickel steel is better able to stand this kind of sudden strain. For this reason, together with its greater strength and stiffness, it is being extensively used for shafts, piston rods, bearings, propellers, etc.

In hull plates for vessels of nickel steel, with an elongation of 20 per cent., a tensile strength of 85,000 lb., and an elastic limit of over 60,000 lb., have been obtained. Similar material of ordinary steel would have a tensile strength but little over the elastic limit of the nickel steel, with an elastic limit about one-half that of nickel steel. In the case of a battleship, where the question of weight is of such vital importance, a hull of nickel steel of equal strength and stiffness to one of ordinary steel would mean a saving of weight of 500 to 600 tons at the lowest estimate; this weight, added to the armament, armor, coal, or divided between them, would add a large percentage to the efficiency of the ship.

Mr. Kjellberg, to whom I have previously referred as the managing director of the Bofors Steel and Ordnance Works in Sweden, tells me that they have found, from the trials made, the fullest confirmation of the fact that a suitable addition of nickel to steel exercises a highly beneficial influence on the steel. It causes a very marked increase in the elastic limit and tensile strength, while at the same time the elongation is greatly increased. As a general rule, they add about 3 per cent. nickel to steel containing 0·3 and 0·4 per cent. of carbon. The properties already referred to are those which show themselves in the testing machine, and as regards their nickel steel, which, after casting is merely annealed, hardened in oil, and tempered, but neither rolled, forged, or otherwise manipulated, it may be stated in normal figures that its tensile strength is 70 kilos. per square millimeter—44·4 tons per square inch—elastic limit 45 kilos. per square millimeter—28·5 tons per square inch—and elongation 25 per cent. on a length of 200 mm.—7·87 in. But all the physical properties of the steel do not, as a matter of course, show themselves in the testing machine; they can only be thoroughly ascertained by practical trials.

From the trials which have been made, they have arrived at the conclusion that the beneficial influence of nickel on the properties of steel is far greater than one might be led to suppose from the results obtained in the testing machine as taken by themselves. The following trial made by them is an interesting one: In one of their cast steel—nickel steel—gun tubes they placed an ordinary cast iron shell in such position that the center of the shell was 300 mm.—11·81 in.—from the muzzle of the tube. The shell was filled with compressed picric acid 170 deg. When exploded the shell burst into little bits, but the gun tube did not burst; and the only effect of the explosion was that the diameter of the tube was expanded by 1¾ mm. —0·07 in. Another similar shell, into which a similar quantity of picric acid had been poured, was placed in the same tube, and in exactly the same position as the previous one, and again exploded. The explosion had no effect whatever on the tube; it did not even increase the diameter further.

For the purpose of an armor plate trial, two nickel steel plates were cast 2,440 mm.—88 in.—long and 1,830 mm.—72 in.—wide, the one being 90 mm.—3·54 in.—and the other 96 mm.—3·78 in.—thick. Five shots were fired at each from a 12 centimeter—4·72 in.—rapid firing gun, the projectiles being of Bofors steel and weighing 21 kilos.—46 lb. The charge of powder was 337 kilos.—7·3 lb.—and the velocity of the projectile at a distance of 46 m.—150 ft.—was between 361·8 and 364.4 m.—1,190 ft. and 1,200 ft. Each of the steel projectiles rebounded intact without having penetrated the plate farther than to the cylindrical parts of the shells, and upon examination of the plates, small cracks were with some difficulty found to have resulted from shot Nos. 2, 3, 4, and 5 on the 90 cm. plates, but none could be found on the 96 cm. plate. Seven more shots were afterward fired with similar projectiles, but it was not until the eleventh shot that the plate broke. The twelfth shot was fired with a charge of 4·10 kilos.—9 lb.—of powder, the projectile having a velocity of 413 m.—1,350 ft.—and then the 90 cm. plate was at last penetrated. It is worthy of note that, according to Krupp's formula, a projectile such as this —that is to say, weighing 21 kilos., and having a velocity of 413 m.—ought to penetrate a wrought iron plate of 150 mm.—5·9 in.—in thickness; and it follows therefore that this 90 cm. nickel steel plate was 54 per cent. stronger than a wrought iron plate of 90 cm. A large experience in making steel for war materials satisfies Mr. Kjellberg that he never could have attained the results he has done without the assistance of nickel.

The Iron Age, published in New York on July 25 last, gives the following interesting account of some welding experiments made by the Canadian Copper Company, who have recently had some trials made in welding nickel steel. In each trial two pieces, each 1 in. square by 6 in., were welded together with a lap weld, with the following results: No. 1: Samples containing 2·05 per cent. nickel and 0·22 per cent. carbon cut like soft steel, welded perfectly, no sign of weld showing; bent twice at right angles at the weld when hot, the weld did not open, nor was any crack noted; bent at right angles when cold, failed to show any crack at the weld. No. 2: Samples containing 3·25 per cent. nickel and 0·16 per cent. carbon, worked exactly like No. 1 under the same tests; no crack was developed, and the metal welded perfectly. No. 3: Samples containing 3·40 per cent. nickel and 0·31 per cent. carbon cut a trifle harder, also hammered like a harder steel; welded perfectly, bent hot and cold like No. 1, and showed no crack. The weld cannot be seen. No. 4: Samples containing 2·62 per cent. nickel and 0·19 per cent. carbon worked exactly like Nos. 1 and 2. The same tests did not show any weakness at the weld. No. 5: Samples containing 3·20 per cent. nickel and 0·54 per cent. carbon worked a little harder, but gave a perfect, solid weld. There were no cracks on bending hot and cold. No. 6: Samples containing 3·10 per cent. nickel and 0·96 per cent. carbon worked harder, i. e., like a tool steel, welded perfectly, and showed no cracks on bending hot and cold. No. 7: Samples containing 4·95 per cent. nickel and 0·51 per cent. carbon worked like No. 5, but not so hard as No. 6. The weld was good, and no cracks developed on bending.

In general, the percentage of nickel does not affect the welding power at all. The steel must be treated like any other steel, using more care with the higher carbons. Having a material which has an elastic limit about equal to the ultimate strength of ordinary steel, with a tensile strength 30 per cent. higher and an equal elongation, together with very satisfactory uniformity, and better qualities for special purposes, such as greater ability to resist shock, and less liability to corrosion, why should not this material replace the ordinary steel of to-day, as it replaced wrought iron? There appears to be no answer to this but possibly one of cost.

With regard to cost, this has not, and will not, prevent the use of nickel steel in many cases where its better qualities make the increased first cost of the material a secondary consideration. Since the price of ordinary steel has been so greatly reduced in the last ten years by improvement in the manufacture, will not this be the case with nickel steel? Nickel steel can now be furnished at the price of ordinary steel a few years ago. Will not the increased demand for this material, which it is certain will now come, cause a similar reduction in its price as soon as the manufacture of nickel steel becomes sufficiently extended and improved? This also will no doubt improve the quality of the nickel steel. Ordinary steel has had its innings. In this age of progress and development no material can long remain that is exclusively or even principally used. When a better is known, it will be employed. Have we not in nickel steel a better material than the ordinary steel of to-day?

CARE AND TREATMENT OF OLD PEOPLE.*

By SAMUEL G. DORR, M.D., Buffalo.

THERE are several important practical considerations connected with age, be it either youth, infancy or old age. I will speak, however, of old age—that time beyond fifty.

As our bodies approach close to this half century mark, congestion and slow degeneration of the tissues of important organs take the place of inflammation. After fifty, the body begins to show signs of loss of power and sluggishness of function, which is but the prelude to that sure, although it may be slow, decay, the progress of which is indicated by diminished sensibility, impaired memory, muscular weakness, scanty secretions, calculous affections, osseous deposits and organic visceral conditions. The death rate statistics show that at fifty-five, three-fourths of the population have passed from the face of the earth. During the next thirty years, which is the period of life from fifty-five to eighty-five, there is a death rate of twenty-three in a hundred, and this leaves just two out of a hundred who live beyond eighty-five years. A strange fact comes in here, and that is that the middle ten years of this last mentioned thirty years, which is the period from sixty five to seventy-five, is most fatal.

In fevers of old people, the mortality is five times greater at sixty than it is at ten, and four times greater than it is at twenty years of age. Under Care and Treatment of Old People comes the consideration of two very distinct classifications. First, that peculiar to the individual, such as heredity, diathesis, temperament, sex, age, and the like. Second, those things external to the individual and constituting the environment, like air and climate, place of abode, food, water, occupation, habits and mode of life. In these last things the doctor who treats and cares for old people must find his success, if he finds any success at all. Medicines and prescriptions will avail but little in lengthening life beyond the average where the environment and habits of the patient are wrong.

It has seemed to me that the atmosphere, with its heat and cold, its dampness and dryness, its dust, smoke and other conditions, has on the patient a power for good and evil little thought of by our general practitioner.

To advise removal from one state to another is not always possible, but to advise removal from one room to another, and being in the right heat and circulation of air, will always be practicable. When we contemplate the large amount of surface exposed by our bodies to the air and atmospheric conditions, we will at once recognize the importance of proper conditions, such as purity, temperature, humidity, and the like. The respiratory organs and air passages, made up as they are of nose, throat, larynx, trachea, bronchial tubes, bronchioles and air vesicles, about which are looped and massed the capillaries of the pulmonary circulation involving the action of the right side of the heart and the aeration of the blood, we are, at least, interested; but when we calculate the effect of atmospheric changes on the skin, that great organ in which we must live, with its glands and nerves, and its capillaries, forming a large section of the terminating loops of the circulation from the left side of the heart, we must be convinced of the importance to longevity of proper atmospheric conditions.

The skin and the lungs do not degenerate and give out purely by reason of age, as do the eyes, the ears, the teeth and the circulatory system; therefore, if the being were never exposed to anything but pure air in a perfect climate, these organs would remain useful far beyond the average limit of life. If good air is conducive to length of life, the place of abode is proved to be a valuable factor in treatment.

Food and water, like the air we breathe, must be suited to our wants. We cannot dismiss these by saying they must be pure food and pure water. The fact is, they must be adapted to the wants of the patient, the same as medicinal substances. They may in the past have produced disease in the patient, although quite pure. The term pure cannot be made applicable to food and water, as many patients would be improved by water which contained some foreign substance, or food having that which is required by the body for its preservation. While we look for pure air, we must not look for pure water and pure food alone, but rather we must look for the water and food to contain that which is required by our patients.

In the aged, the teeth are frequently absent and the stomach is weak, hence difficulty in mastication and digestion; and with digestive difficulties come a larger number of other difficulties. When the old, weak stomach is given too large or too difficult a task to perform, the sympathetic system of nerves is deranged fearfully, and life is frequently cut short by apoplexy or acute disease. When too large an amount of food or improper food is put into the stomach, too much for perfect digestion, there must be produced a vicious product in the system as a result. If the body, by reason of age, is unable to digest freely and perfectly a given amount of food, it is quite reasonable to suppose that the elimination of these vicious products would, by reason of the same age and consequent weakness, be very much delayed. For the above reason, it seems to me that elimination by all the organs of the body, not forgetting the skin, is quite imperative.

So far as water and liquids are concerned, I find myself forced to the conclusion that far too much is contained in the average individual. The circulatory system is under too great a strain, by reason of its fullness. Every pulsation of the heart produces an overstrain, and the elasticity of all the vessels composing the circulatory system is too early in life destroyed through mechanical effect, produced by a too large volume of blood in front of each pulsation.

Next in order mentioned comes occupation, and if food and water must be adapted to the wants of our patients, none the less must their occupation be suited to their peculiarities; and it is not to be forgotten that aged people are quite likely to have peculiarities. There are those deep thinkers, like Gladstone, Bismarck and others, who must have hard mental work late in life. Reasonably protracted muscular work will bring sleep and act as a sedative very refreshing to nature. A perfectly selected occupation becomes an amusement which engrosses all attention and distracts all thoughts from other subjects. A few minds and a few bodies have to lie inert, they being worn to exhaustion. I recollect how intelligent was the mind of Mrs. Fillmore at the age of 106, when the body was weakened to that extent which prevented largely the use of the extremities. In her we have the example of the possibility of the brain outlasting the muscle, if cared for. Occupation of the muscles and the mind suited to the individual is conducive to longevity, while occupation unsuited to the individual is the reverse.

Habit, that wonderful plan of our nature, which is but the repetition of sensations, thoughts or movements, which are at first distinct, and may have been difficult, although voluntary, at last transfers us from the domain of attention to the domain of association; and when the influence of association becomes predominant, as it will in most characters after long years of repetition, then the individual is a slave to habit. He can no longer enjoy new sensations, new thoughts or new movements. Every year of our lives places the yoke of habit more heavily upon our necks. The lives of old people are frequently cut short by habits which are persisted in with a full knowledge of their dangerous effect. Of all things on this earth and under the heavens, so far as the knowledge of man goes, habit is the most powerful influence for good or for bad which affects advanced life.

Old age and bad habits do not go together. Old age can only be to them who have no bad habits, or who have sense and will sufficient to correct them; or who as perpetual youths have never let their sensations, thoughts or movements run in the rut of associa-

* Read before the Medical Union, June 20, 1895.—Buffalo Med. Jour.

tion, but have always held them under their attention and subject to the dictates of a wise judgment.

When your patient cannot resist a dangerous habit, and when there is no help or influence in the family of the patient to assist him or her to resist that which leads to destruction, then, as medical men, you may enter a prognosis of failure in your attempt to lengthen life beyond the average. There is no occasion for me to mention a long list of bad habits in this paper, but, as a fact of personal observation in my practice, I have to state that coffee, beer and tobacco are sending to the grave a fearful amount of people who are too young to die by natural causes.

Habits of one kind or another are in constant warfare upon every organ or system of our anatomies. The divine teachers tell us that Habit carries her victories beyond this terrestrial sphere and destroys the soul, thus robbing us of both the future and the present. Some writer has said that the length of life is the duration of our arteries; and as I think more and more on this assertion, I am impressed with its implied truth. The pulsation of the heart is the water hammer which, by repeated blows, finally destroys the structure, thus constituting the physiological duration of our existence.

The heart must beat, and these beats are caused to deviate more or less from the standard of perfection by mode of life and habits of the individual. The heart, like the skin, brain and lungs, escapes the failure due purely to advanced age. The nutrition of the heart is especially provided for, and you always find the normal heart of old people hypertrophied. Some writers have made the error of stating this proposition in the light that old people have attained to old age by reason of having been possessed of strong hearts. The hypertrophy of the heart is physiological, whereas the alterations in the arterial coats whereby they lose their elasticity is pathological, and may, and may not, be the cause of the hypertrophy and dilatation in the heart.

There is so much to be said on this subject that it is best to stop all except very practical questions in this paper. Over-indulgence in food induces plethora, corpulence and loads the tissues with fat, which is a most dangerous condition for old people. Gluttony and the abuse of stimulants sends many to the grave. Prolonged exertion, violent emotions, petty troubles, are daily causes of death. Gouty conditions and irregularity of heart's action are difficulties arising largely from faulty nutrition and defective elimination. The food of old patients with irregular heart's action had better be strictly regulated and persistently adhered to. I would recommend for breakfast, dry toast, a cup of tea with cream and sugar, and nothing else. For dinner, a little lean mutton, or chicken, or fish, dry toast, but no vegetables; a little brandy, tea or hot water. For supper, dry toast, fish boiled, tea or hot water. At bed time, four or five ounces of hot water. This diet is for extreme cases of heart weakness, and when associated with proper medicinal agents will seldom fail in its purpose.

The hasty conclusion of this paper has been brought on by the feeling that it is now too long.

THE SEA SERPENT OF THE NEWSPAPERS.

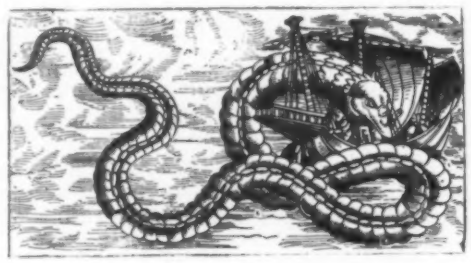
The serpent of the newspapers, otherwise called the sea serpent, might become a reality upon which more attention could be bestowed than upon its imaginary counterpart. Its origin, it is true, is not very ancient, for we find traces of it only as far back as the fifteenth century, among Norwegian sailors. But since then it has offered us a gloriously fulfilled career. With the advent of the journals of the middle ages, it did not cease to fill their columns. Bolder than its rival of antiquity, the famous sphinx, especially celebrated by the profound enigma that it offered to Œdipus, the sea serpent has never wanted to disappear for good.

It is true that it had not statues at its disposal, like its fortunate Egyptian rival, nor oracles either, as in Greece or Rome, but it did have and has still a much greater force to call upon, and that is the power of the press. It is a curious thing that the sphinx itself was likewise desirous of having the support of a paper, the Acta Diurna, the Roman journal, but that tentative hardly succeeded. In reality, when Chrestus, the Chicholle of the epoch, announced its appearance in the Acta Diurna (when, under Claudius, one went so far as to exhibit a sphinx), it sufficed for Pliny and several other scientists to assert that the sphinx was as false as the paragraphs of a newspaper in order to have the sphinx interred for good. The reason was that the press was then as yet too feeble to uphold the sphinx, and it died for want of care.

The sea serpent has been much more fortunate. We might say of it that if it has been seen by sailors, it has in all times been nourished by journalists. These latter, in a search for news, have ever had recourse to the obligingness of the sea serpent, which has never refused them its brilliant and efficient aid. The number of journals that owe their success to it is incalculable. Its most recent triumph has doubtless been the sudden rehabilitation of the Constitutionnel, which, upon the eve of its ruin, placed itself under the protection of the sea serpent, that compassionate patron of newspapers.

Later on it became the turn of a small Polish journal, the Dziennik dla Wszystkich, which, upon the point of failing, had the ingenious inspiration to likewise make use of the infallible serpent. This occurred about 1880, that is to say, after a dozen years of oblivion for the sea serpent. The circulation of the journal increased from day to day, and this well exploited mine gave the Dziennik a success that was as durable as if it had sent some Stanley or other to an unknown country.

But, although journalists joke in their inner consciousness, sailors believe in it ardently. The periodicity of the appearance of the sea serpent in narratives, the sincere and convinced tone of so many brave captains, who assure us that they have seen and even photographed it, give us food for thought. And suppose, after all, there is something true in this snake story that has already turned the heads of so many people of note. The sea serpent, a source of success to the journalists who invented it, has, however, always been a source of sorrow to the sailors to whom it has



A SEA SERPENT ATTACKING A SHIP ACCORDING TO OLAUS MAGNUS.

deigned to exhibit itself; since they have been accused of insanity and disordered imagination. Captain Cringle, the bold English mariner who saw the sea serpent in December, 1893, exclaims in the report that he sent to the English Admiralty:

"I have been rendered so ridiculous on account of my sea serpent, that I greatly wish that some one else had seen it in my place."

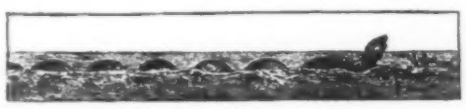
Poor Cringle! He is not the first and probably will not be the last to see it.

Our readers will doubtless find with us that, true or false, the sea serpent is worthy of being spoken about anew. If true, it would throw a curious light upon the fauna of the sea that still hides so many mysteries.

THE SEA SERPENT SEEN BY BISHOP EGEDE IN 1734.

If false, it is peculiarly interesting as regards the psychology of human aberrations, for, what is a curious thing, the sea serpent has just reappeared in England, where it finds more believers than ever. Its worship is not confined to sailors and the simple, but begins even to stir up the English magazines, one of which, the Strand, from which we borrow several of the accompanying curious figures, well characterizes the average faith of our neighbors across the channel.

They ask, not without an appearance of reason, Is it possible that so many intelligent and sincere people should be deceived for a series of centuries? And, after all, why should not the sea serpent exist, while so many monstrous creations of the sea have become



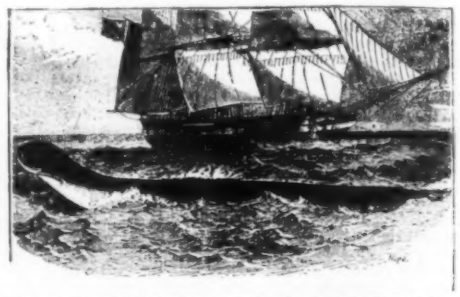
THE SEA SERPENT ACCORDING TO PONTOPPIDAN.

realities? And are all the pictures of the sea serpent that have been bequeathed to us by those who have seen it down to the photographs taken in recent times merely pure inventions? For, to tell the truth, the imagery of the sea serpents, of which we have given the most curious facsimiles, is as rich as the prose descriptions that have been devoted to them. Olaus Magnus, who saw one of these serpents in the sixteenth century, has bequeathed to us a most terrifying description of it. It attacked a boat, and not content with spreading terror among the crew, stuck its head into the interior of the vessel and seized an unfortunate sailor, whose desperate attitude may be seen by our readers.

Bishop Egede, who devoted his time to the conversion of the poor Greenlanders, saw a most terrible sea serpent with his own eyes in 1734. Its head, when it deigned to raise it out of the sea, reached as far as to the main top, the water flowed from its mouth as from that of a whale, it had large claws, its body was covered with scales and its skin was rough and uneven. In all other respects, says the excellent bishop, it was a true serpent, and when it plunged into the water its tail, which was in the air, seemed to be distant from its body by the entire length of the boat. The missionaries who accompanied Egede made the very explicit drawing that accompanies our article.

The famous Norwegian naturalist, Erik Pontoppidan, Bishop of Bergen, after converting many infidels, was himself finally converted to the religion of the sea serpent. In a work published in 1755, he certifies to the existence of a sea serpent "according to the testimony of a hundred mariners."

It is to be remarked that bishops, in conjunction

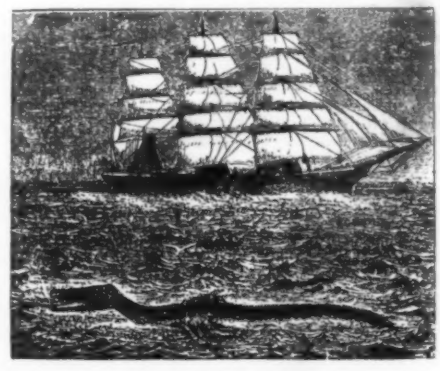


THE SEA SERPENT SEEN BY THE CREW OF THE DOEDALUS.

with sailors, have in all times believed in the existence of these monsters, which, to them, merely corroborate the "leviathan" of the deep as it is offered to us by the Book of Job. Pontoppidan makes open allusion to the leviathan of the Bible, and teaches us that the sea serpent and the leviathan are but one and the same being, which always remains at the bottom of the sea except in July and August, when it makes its appearance at the surface of the water.

One will doubtless not fail to remark that the sea serpent has selected just those two months in which newspapers most suffer from a dearth of news! However this may be, the bishop, carried away by his soul-stirring subject, goes so far as to furnish us with intimate details of the life of the serpent. He gives 600 feet as its exact length. Its eyes were enormous, and the color of its skin was as black as ebony.

Let us pass to some more recent appearances of the serpent. The one that made the most stir has been transmitted to us by the officers of the ship Doedalus, and happened in 1848. It was in the month of August (how could it be otherwise?) and the gravest journal of our epoch, the London Times, believed it likewise useful to regale itself with the luxury of a sea serpent. The incident reported by the great journal excited the whole of Europe, and had it not been for the revolutionary storm that was muttering throughout the world, the sea serpent of 1848 would have doubtless left deeper traces in the history of the sciences. The English Admiralty was moved by it, and, in response to its request, Mr. M'Quhae, the captain of the Doedalus, wrote as follows to the English admiral, Sir W. H. Gage, under date of October 11:

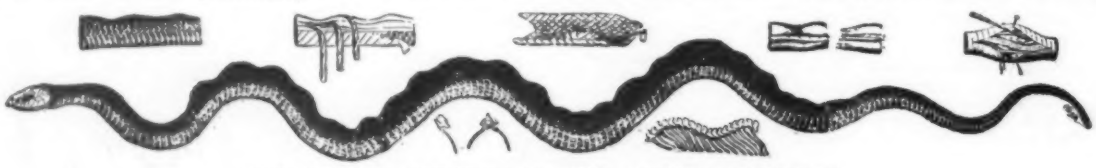


THE SEA SERPENT SEEN FROM THE SACRAMENTO.

"Sir: In answer of your letter to-day asking explanation as to the veracity of the account published by the Times upon the gigantic sea serpent seen by the crew of her Majesty's ship Doedalus, which is under my command, I have the honor to inform your lordship that upon the 6th of August last, at 5 o'clock in the afternoon, in 24° 44' south latitude and 9° 22' east longitude, something unusual was observed by Mr. Sartoris, who communicated the fact to Officer Edgar Drummond, who was with Mr. William Barrett and myself. The crew was at supper at the moment. We examined the object, which was found to be a huge serpent with a head four feet in length. Its body, which was flush with the water, was about sixty feet in length. It passed so near our vessel that had it been a question of a man I should have recognized all the traits of his countenance. It was advancing straight toward the southwest with a speed of from twelve to fifteen miles an hour. Its color, which was of a deep black, had a yellowish tinge toward the neck. It had no fins. It was seen by all of us, and I succeeded in making a drawing of it immediately after losing sight of it.

Captain Peter M'Quhae."

The great English journal, the Globe, signalized it-



THE FAMOUS SERPENT OF THE LINNEAN MUSEUM.

self shortly afterward by its description of a serpent like that of the Doedalus, that was seen by the crew of an American vessel, the Daphne, en route for Europe, and then fine times for the serpent began. The journals of England were filled with its doings between 1849 and 1855.

The laurels of the brave M'Quhae did not permit the captain of the ship Plumper to sleep, since, toward

THE SEA SERPENT SEEN BY THE CREW OF THE PLUMPER.

the end of the same year, he observed in the vicinity of Oporto, a "long black animal having a from 6 to 8 foot head and a body of unheard of length, for the officer saw but 50 or 60 feet, which appeared to be but an insignificant part of its body."

A still more astonishing serpent defiled before the crew of the ship Princess and its captain, A. K. N. Tremaine. We give herewith a sketch of it as made by the captain and reproduced in the Illustrated London News of the time. The thing occurred in the month of July, 1853, in a place situated at 34° to 56° south latitude and 18° to 14° east longitude. Captain Morgan, who chanced to be upon the boat, bore witness to the veracity of the entire crew.

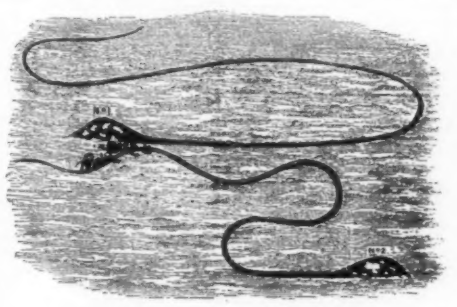
At the beginning of the year 1857 a certain Mr. Fairbridge filled the English and American journals with the most curious details as to the sea serpent, which were corroborated later on by Dr. Biccard at Cape Town. The matter was so much the more curious in that the doctor twice fired at the monster, and tried to present proofs of it in the form of two sketches, the first of which represents the serpent before the shot and the second the monster as it appeared after the ball grazed it. A glance will suffice to show that Dr. Biccard's serpent in nowise resembles its glorious predecessors.

Captain Hassel certifies to having seen, before reaching Texas (1872), an exceptional serpent, whose

THE SEA SERPENT SEEN BY THE CREW OF THE PRINCESS.

70 feet visible upon the surface of the sea seemed to form but one-third of the animal.

But the most dramatic and moving scene to which the serpent ever desired to be a party was, without doubt, that which was given Captain Drevar to see and illustrate in 1875. It concerned neither more nor less than a duel to the death between the sea serpent and a whale. The thing occurred in the month of July, near Cape Roque, at a distance of twenty miles from Brazil. The sky was clear, and the sea greatly agitated. Waterspouts arose from the surface, and a strange noise filled space. Suddenly the columns of water disappeared, and the captain, in company with his suite, perceived a sea serpent strangling a gigantic whale in a mortal embrace. Two young whales were desirous of aiding their menaced comrade, but trembling with fear, kept themselves at a distance. Then an infernal noise arose, columns of water spurted into the air, and the whale was thrown into space, and a few minutes afterward fell back into the depths of the sea. The two young whales kept all the time in proximity to the ship, but an hour afterward everything had become calm, and of the gigantic contest there remained only this document signed at Liverpool before the commissary of police by all the witnesses: "We, the undersigned, the captain, officers and crew of the ship Pauline, sincerely and solemnly swear to having seen, on the 8th of July, 1875 (in 15° 13·5' latitude and 35° west), three whales, one of which was surround-



THE SERPENT OF DR. BICCARD.

ed by an object that we believed to have been a sea serpent. The serpent strangled its victim for fifteen minutes, and then buried it in the depths of the sea."

The serpent disappeared, however, for a certain period, but reappeared with the crew of the ship Sacramento, whose captain, W. H. Nelson, and several officers saw about forty feet of a sea serpent. Have we need to add that this occurred in the month of July (1877)! In the same year and at nearly the same time, the crew of the ship Osborne met with a sea serpent in the vicinity of Sicily, and Captain Hassel has given a sketch and a most important description of it.

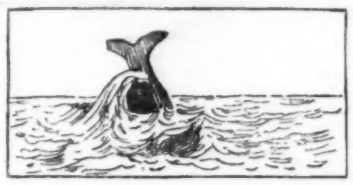
The Graphic, in publishing in 1879 a description of the sea serpent observed by its special correspondent, Major H. W. J. Senior, excels all the preceding narratives. Major Senior, let us say to his advantage, doubtless frightened at the gravity of the things seen, gives us in a picture in the Graphic everything except the head of the monster.

The year 1893 was particularly favorable for the sea serpent. First it was Dr. Matheson, of London, that, after seeing the serpent, gave a detailed description of it in the journals of that city. According to this learned specialist of London, the serpent resembles the

A SEA SERPENT ATTACKING A WHALE.

giraffe, although its neck is much longer. The animal disappeared and reappeared several times.

The sea serpent as seen and sketched by Captain Cringle, of the ship Umfulli, doubtless inspires more confidence than its numerous rivals of the past. Let us say before all that the event took place in 1893 in the month of December. Nothing but this circumstance made something entirely exceptional foreseen.



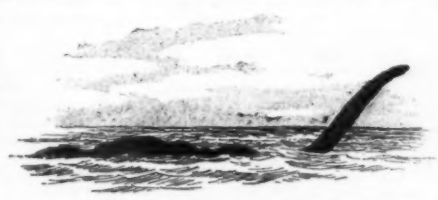
THE SEA SERPENT SEEN BY CAPT. DREVAR IN 1875.

The serpent was swimming not far from the vessel along about half past five in the afternoon. It was about eighty feet in length and was as large as a whale. The thing occurred between Capes Bajador and Blanco, near the Canary Islands. The animal showed from 15 to 20 feet of its body and had a skin of a dark color.

Something occurred at London, however, that paralyzed the good will of all the amateurs of sea serpents for a long time. Poor Captain Cringle, as we have above said, was so ridiculed by the papers that he finally swore by all that was good and bad that he would never speak of his marine monster further. Poor Cringle! why did he observe his serpent in the month of December, when all the newspapers have something else to do than to bother themselves about sea monsters, instead of seeing it in the months of July and August that have always brought good luck to all the observers of the sea serpent?

Much more fortunate, some weeks ago, was the serpent of Long Island Sound, which made its debut in the month of July, and even allowed itself to be taken in the month of August, 1895. All our American contemporaries rejoiced in advance over the fact that the reality of the sea serpent was finally going to be solemnly proved!

How was it taken? Simply by three shots that mortally wounded it, and thanks to a simple rope that



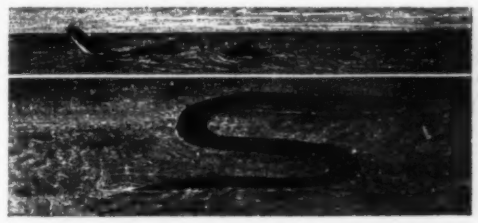
THE SEA SERPENT SEEN BY CAPT. CRINGLE.

three penitentiary keepers of Blackwell's Island passed around its neck.

Let us add that, according to the American descriptions, the serpent was provided with fins, and was 25 feet in length and 168 inches in circumference at the thickest part of its body. The head, although of remarkable size, had truly the form of that of a serpent, and the jaws, which had an opening of about six inches, were provided with a double row of curved teeth.

The last exploits of the sea serpent were communicated to us by Mr. Jean Hess in the Figaro for August 21. The author tells us about having seen a very large sea serpent swimming in the midst of the Strait of Malacca, in the open, at a very great distance from the coast. Mr. Hess, however, refrains from giving us its dimensions and its physiological peculiarities.

Is the sea serpent, then, merely a myth? Such a conclusion would be inevitable should we compare the series of drawings made by all those who claim to

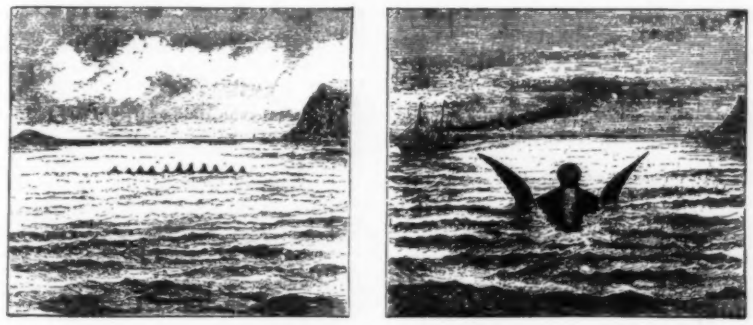


THE SEA SERPENT SEEN BY CAPT. HASSEL.

have seen it. As such drawings are diametrically opposite, it would, consequently, be necessary to liken the sea serpent to a chameleon that not only changes color, but also head, body and length. But, on another hand, what are we to make out of so many certificates of intelligent people who are disinterested and of good faith?

Let us recall, moreover, the fate of the curious animal called the ornithorhyncus, and show ourselves more clement to the believers in the sea serpent. When a skeleton of this strange animal, part bird and part quadruped, was brought for the first time to Europe, naturalists unanimously declared that it was a question in the species only of a bad joke of some American manufacturer. And yet the existence of this animal, which lays eggs, and occupies with the Echidnas the lowest round in the scale of quadrupeds, has, since 1880, been considered as an incontestable fact.

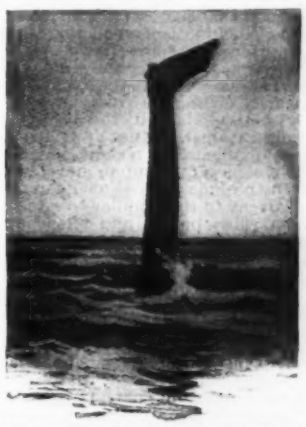
Faith in this strange quadruped preceded by far its scientific registry. We recall having met with it in the romances of Maryatt, who speaks at length of it, especially in the Pacha of Many Tales, wherein he puts into the mouth of one of the sailors the legend of a quadruped that lays eggs like a bird. Some rare savants, and among them the illustrious Geoffroy Saint Hilaire, the founder of embryology, had the courage to speak of it even toward the year 1820. Let us add in parentheses that the ornithorhyncus disengages quite a violent poison, a detailed study of which still awaits some conscientious naturalist. Before living specimens of this half bird were brought to and examined in Europe, it would have been as risky to



THE SEA SERPENT OBSERVED BY THE CREW OF THE OSBORNE.

speak of its existence as it is to-day to believe in sea serpents. These latter, however, present an exceptional case. As concerns them we might apply the backhanded slap of Chamfort at spirits. Everybody, says he, speaks of them, but where are those who have seen any?

The sea serpent, alas! has been seen too much, or at



THE SEA SERPENT SEEN BY DR. MATHESON.

least in too many different ways, to allow us to look at it without certain misgivings. And yet, who knows? The sea with its impenetrable bottom hides so many mysteries from us that we should not be surprised if the sea serpent were among the number. Finally, in order to console the friends of the sea serpent, let us say that they may remain faithful to it without running too great a risk of ridicule. They share it, more-

over, in company with some American scientists and naturalists.

The Linnean Society of Boston, particularly stirred up by the stories spread upon the subject of a sea serpent that in 1817 gave frequent rendezvous to sailors traveling on the Atlantic, appointed a special committee of scientists. It appears that these gentlemen saw in their turn and confirmed the existence of the serpent in a report that exists in the archives of the society. A month afterward a present was made to the latter of a sea serpent in flesh and bone that was killed at Cape Anne. Its dimensions, however, did not correspond with those indicated by the sailors and the committee of scientists. What was to be done? The Americans, in their wisdom, decided that it was the young son of a large sea serpent! They baptized it Scolioplus Atlanticus, and the curious have thus a means of finding evidence of the sea serpent in the Museum of Natural History at Boston.—La Revue des Revues.

THE SOUTHWARD MOVEMENT OF THE BIRDS.

By William Higgs.

Beginning early in August and governed in its initiation by conditions prevailing in the neighborhood of the Arctic circle, the southward movement of the birds continues until late November, and is, indeed, kept up locally to a greater or less degree until midwinter. In the region most familiar to the writer—lying between parallels 42° and 43°, some two hundred miles from seaboard—the first noticeable surge of the returning wave breaks upon us during the third week in August, when the attention is arrested some morning by a restless twittering in the tree tops proceeding from the throats of scores of warblers, and a little later—sometimes in the afternoon of the same day—by the activity of groups of orioles investigating the shade and orchard trees and uttering constantly a questioning note. A visit to the fields and woods discloses nothing unusual in the demeanor of our summer residents; and it is plain that these are birds whose nesting places have been further north, and who are now—some time before the corresponding birds with us find it necessary to depart—on their way to their winter homes. The warblers remain generally only for two or three days, their places being taken by a series of new arrivals until the autumn movement is at an end; but the orioles linger for days together, keeping more or less in scattered groups, however, as if careful about the loss of stragglers, and continuing to betray signs of strangeness to their surroundings alike in their movements and in their high-pitched, restless notes.

In the case of the smaller birds it is possible to observe something like a concerted resumption of their southward flight, the departure taking place usually quite late in the afternoon, and being observed once a little before sundown; but the orioles disappear as inconspicuously as they have come, being visible at sundown one day and invisible at dawn the next, having vanished without a sign. It would throw light upon some of the most interesting problems of migration could one follow these birds on their way and observe the several stages into which their journey is broken up, noting the distances between stopping places, and the features of the localities which tempt them, or the conditions of the atmosphere which constrain them to make their halts; for nearly all our short-winged fliers pause frequently between their summer and their winter homes, instead of, as is the case with the majority of our shore and water birds, making the distance almost at a single flight.

Closely coincident in point of time with the arrival of this first contingent of orioles and warblers is the appearance of flocks of cedar birds, or wax wings, which spend an hour or two foraging among the trees and on the pea vines of the garden in a state of great excitement, betraying in every motion a feeling of unfamiliarity with their surroundings, and then again are on the wing. A little later come occasional flocks of siskins, which feed among the plantation spikes, in the butternut trees, and on the lichen-covered sides of barns in the outskirts of the village for a few hours in the morning, keeping constantly on the move without disbanding, and leaving—in the two or three instances in which the writer has been able to keep an eye upon their movements—as soon as the fog, which at this season is apt to prevail early in the day, has been dissipated by the sun. Both these birds are permanent residents of points nearly on a parallel geographically, and almost identical climatically, with the region covered by these observations; but in this locality their movements display all the characteristics of a true migration; and I have never met with an individual of either species after the winter has well set in—a condition to be accounted for, in all probability, by the scarcity of coniferous trees.

Intimately connected with the behavior of these birds of simple transit, is that accession of nervous activity, accompanied by a tendency to flock together, which comes upon upon our locally nesting birds and is the prelude to their own departure. Seen most conspicuously in the familiar congregating of the swallows upon ridge boards and telegraph wires and the denuded tops of trees, it is yet readily observable among the robins and bluebirds, and less noticeably among our native sparrows—these last taking their departure from the secluded fields and hillsides and so escaping the attention invited by our village-haunting birds.

For weeks previous to the departure of any of these, however, there have been evidences of a concerted movement among the bobolinks, the birds assembling in scores upon the ripening oats, foraging avidly for a few days, and then suddenly being lost to sight. The flocks are composed, so far as it is possible to distinguish, wholly of young birds in their first season's dress, and are made up apparently partly of local nestlings and partly of a more northerly bred contingent, broods from several areas joining forces along the route and continuing their flight in concert. As is generally the case with birds whose offspring mature early, it is the young bobolinks that begin the autumn movement, the parent birds finding some delay necessary to the completion of their pre-migratory moult; a condition of things which adds to the mysteriousness of the impulse which initiates and guides their flight. The young cuckoos of the Orkneys and Shetlands—which have never seen their parents, having been hatched and reared by non-migratory pipits after the old birds have left the islands—traverse the same flight lines, through Britain, France and Spain, and across the Gibraltar Strait to their winter haunts in Africa, as have been taken by their ancestors for ages; though under what natural prompting, or in obedience to what purely material constraint upon the consciousness, it is impossible to conceive.

The regions over which these observations extend lying partly within the field of flight traversed by those shore birds whose lines stretch from the tide waters of the Delaware and Chesapeake to the sands of Hudson's Bay, it sometimes happens that any unusual condition of the weather—such as persistent fog or storm—during the period of migration, introduces one to stragglers among the ducks and plovers not ordinarily to be met with. During the prevalence of a heavy fog in September of last year what was almost certainly a bunch of ring-necked plover was flushed two or three times from the slub beside a local pond, though the species is one not previously known to have occurred here; and the field or grass plover is apparently an irregular autumn visitor along the line of grassy hills which form the backbone of the region, being as approachable at such times by men working in the fields as the junco or the socialis. Woodcock and snipe receive additions to their numbers every autumn here, the tale of locally nesting birds being too small to account for their abundance in favorite localities, and the increase showing suddenly as if the birds had come by night—which, indeed, the woodcock do. It is probable that birds whose summer range extends to the Labrador peninsula descend in small numbers on migration at various tempting points along the line and remain, if undisturbed, perhaps for weeks.

Robins and bluebirds leave in flocks and frequently travel in company—some birds being social as well as gregarious while on migration, though not at other times—the approach of the time for their departure being announced several days before the actual start, by the birds performing aerial evolutions together in bunches of two or three dozen, very often at a height of four or five hundred feet. As is the case with nearly all our songsters, the date of their disappearance is preluded by two or three weeks of more or less vocal activity, as if the birds before they left had tantalizingly determined to remind us of the copiousness of their spring performance.

Sparrows congregate about the hillsides and open pastures by the middle of October, or even earlier, and many leave us during the next tendays. Scattered birds, however, remain until well along in November, and may be seen flitting about sheltered hollows and on the sunny side of walls even when the ground is white with snow. In an open season I have watched the humming bird—whose tiny wings have to transport it over so many leagues between its northern and its southern home—on the last week in September, flinging riantly from flower to flower, as if oblivious of the impending cold.

The wood thrush departs by the first week in October, and is closely followed or else preceded—for on this point my observations do not convince me—by the veery; but the hermit remains a week or ten days later, and I have come upon it once, in a dense and sheltered wood, as late as October 25.

In the case of locally nesting birds the observer who has watched the departure of the main body of a certain species need not be surprised if he comes upon stray individuals a week or two weeks later, apparently quite unexercised by the disappearance of their comrades. Many causes conspire to extend the period of migration in the case of individual birds, and these have probably had their moulting extraordinarily delayed from accidental causes, and are patiently awaiting the restoration of their plumes. The writer once came upon a vigorous, healthy-looking male robin in perfect plumage, on November 20, at least three weeks after the main body of the robins in that region had disappeared, there being no ostensible reason for the lateness of his setting out. No other birds of his species were discoverable; and the only explanation to suggest itself was that this bird had but recently recovered from some mishap which precluded an earlier start. The fact that he was not seen again in the neighborhood renders it probable that the robin undertook alone, or in company with some stragglers who had been similarly handicapped, the journey which the coming on of winter made imperative and which the bulk of his companions had undertaken long before.

McDonough, N. Y. —The Independent.

THE NORTHEASTERN COAL FIELD OF ILLINOIS: MINES AT GARDNER, BRACEVILLE AND CLARKE CITY—GEOLOGICAL PHASES—NEW MACHINERY—THE MINERS.

At the East we are accustomed to thinking of Illinois as an agricultural State, but in the northern half, at least, the productiveness of the soil does not impress the visitor more than do the manufacturing interests and the mineral wealth.

The pretty and prosperous towns along the Rock, Fox, Kankakee and Des Plaines Rivers have millions of dollars invested in shoe, watch and furniture factories; in paper, cotton and knitting mills; in creameries and condensed milk establishments; in steel and iron works; in enormous carriage, wagon and farming implement manufactories.

Leaving Chicago by the Chicago & Alton Railroad, we pass through Joliet, where rolling mills and the extensive limestone quarries have contributed to the growth of the place, and we are soon in the heart of the northeastern coal field, or the first of the five mining districts into which Illinois is divided. The output of the entire State last year was 17,113,576 tons, and of this 2,685,244 tons were mined in this field, composed of Grundy, Livingston, Will, Kankakee and La Salle Counties. There are 72 mines now open, and the long lines of loaded cars one sees on the switches of no less than six important railways indicate better than figures what energy is being spent below ground.

It is a most interesting field for observation, and no more appropriate vantage point from which to study it could be found than Gardner, Grundy County, 64 miles south of Chicago. It is appropriate, because here the first excavations were made to determine whether coal brought to the surface when wells were sunk was really to be found in paying quantities. In 1865 the first shaft was put down here, and the good coal taken out was hailed with delight by the settlers in the scantily timbered region. It sold faster than it could be mined at more than six dollars a ton, the miners receiving half of the price for their labor.

Thirty years have brought the same great changes here as have come to every part of the industrial world; as in other places, the most serious ones have come within the last half decade. The original shaft was long ago abandoned; another a mile distant has been worked for about thirteen years. Into the cool depths of this mine I descended one warm July day. The vein, three feet thick, is 200 feet below the surface. The work of taking it out is very simple. The miners "undercut" it with picks for three feet in the daytime, and during the night it falls from its own weight in masses weighing from one to twenty tons. It is then loaded into cars which are drawn by mules to the shaft and is lifted in the "cage" to the top.

Like all the coal of the State, it is highly bituminous, and is specially well adapted to steam making purposes. The shaft pierces a stratum of amygdaloidal sandstone containing traces of spathic iron and other carbonates; immediately above the coal lies a gray argillaceous shale with laminæ so thin that in places they crumble in the fingers.

As fast as the coal is taken out the miners put in cottonwood, poplar, basswood or hard wood supports for the roof, four cents' worth of wood being put in for every ton of coal taken out. The main passageways, which the company keep in order, have a plank floor and the roof is supported by ash and oak timber. Water drips from the roof and fungi festoon the timbers. In an abandoned quarter of the mine fungi once formed a curtain thick enough to confine a chamber of carbonic acid gas.

The water is brought to the surface by means of steam pumps and the mine is ventilated through a shaft by means of a great fan rotated by an engine. The air is excluded from unused parts of the mine by sail cloth screens and doors set at their openings. Danger to life and limb here is comparatively little from gas, but is chiefly due to the falling of the overhanging rock where the coal has been taken out before the props have been put in place.

The buildings at this mine were destroyed by fire only a year ago, but they have been replaced by better ones containing notable improvements in hoisting appliances. First among these is an attachment to the engine called a "camel back" winding drum.

This is the invention of Mr. J. F. Cooey, the superintendent of the Gardner-Wilmington Coal Company, the owners of this and other mines, and is manufactured by Crawford & McCrimmon, at Brazil, Ind.

The self-dumping cages are also an economical improvement, saving the labor of three men and making it possible for the weighman not only to credit the proper miner with his coal, but to receive it all. As each car is drawn to the shaft it is securely clamped to the bottom of the "cage," so that both are hoisted together to the top of the tower, where the weighman is stationed. There the "cage" presses a spring, tips over and throws the coal on to the inclined screen, through which the screenings drop into a car while the block coal slides over and falls into another car. A bell signal from below warns the weighman that a car of mud, slate or shale is coming up; he reverses the apparatus, the debris is turned in the opposite direction to that given the coal and is dropped into the five-ton cable car intended for its receipt. This is drawn by power from a special engine up a track to the top of the great "mud dump," where, as it passes over blocking in the track, its sides open and the contents are discharged. The sides close automatically and the car descends to its place to receive the next load. A sort of magical process it seems to the uninitiated.

From the top of the "mud dump" of gray disintegrating shale about 100 feet high and several hundred feet in circumference one gets the best view attainable in this part of the world. Absolutely level land stretches as far as the eye can reach, broken only by other "mud dumps" to be seen in every direction; here the irregular piles stand alone on the plain, because the mine has been abandoned; in other places they are increasing every day, and clouds of smoke and steam rise near, showing that work is going on below. Standing on the top of the "mud dump," which it requires a steady head to reach, we look down upon miles of fertile farm land overlying the coal, and bearing abundant crops of corn, rye and oats.

Braceville, four miles from Gardner, is an important mining town. From a single center there no less an area than 454 acres has been worked out, with an average yield of 5,050 tons to the acre. Last spring the mine from which 2,294,285 tons had been taken was abandoned and about a mile away another shaft was sunken to the same rich vein. From this shaft as a center at a depth of 115 feet radiates a new mine where 500 men are now at work taking out about 1,100 tons a day. This entire product is used by the owners of the mine, the Chicago & Milwaukee Railroad, and yet it is far from meeting the needs of this widely ramifying road.

We went into this mine, as the miners do, by way of the air shaft in a clean cage. The coal and debris are hoisted in great, nearly square iron kettles, into which they are emptied from the steel cars used in this mine. These kettles are self-dumping, and from them the coal falls on to a screen to be separated as at Gardner. The coal contains an appreciable amount of iron sulphide, and glistening plates of it were to be seen in a number of the blocks we noticed as they slid into the car.

We saw an interesting invention of Mr. R. Ramsay, the superintendent here, which is used in filling box cars. It consists of a heavy timber about six feet long, to one end of which a sort of double plowshare is attached. This extends into the center of the car that is receiving the coal, and working on a pivot by power from a special engine, it throws the coal to both ends of the car and does the work which once it required ten men to do with shovels. I have seen women doing

similar work by hand at a mine in Belgium; they stood in the middle of the car amid the dust of the falling coal and with their fingers laid it piece by piece where it should be.

Clarke City, in the western part of Kankakee County, is another typical mining town, that being the only industry carried on there, and the population of the low, smutty frame houses being exclusively miners. The Gardner-Wilmington Coal Company have lately abandoned a mine there, which had been worked about twelve years, to work a richer vein nearer the surface, only about 100 feet down, which averages from four to six feet in thickness.* The plant here was selected with very great care and with direct reference to economy in both power and men.

I understand that this is the only mine in the district where machines are used for cutting the coal. Here nine Ingersoll-Sergeant machines are in use; they are run by compressed air, for which a 20 × 24 Norwalk compressor is used. The air is conducted through a receiver on top into the mine; there gas pipes convey it to other receivers, whence it passes through other gas pipes and finally by wire-bound hose to the machine. This consists of a low truck on which the man who runs it sits with his feet braced; his hands grasp two handles attached to a stout steel bar to the end of which a sharp pick is fastened. The compressed air drives this pick into the bottom of the seam of coal, "undercutting" it for four and one-half feet.

A good workman has cut a face of 100 lineal feet in a day, representing 75 tons of coal. Meanwhile, a man on his knees is scraping away the fragments of coal broken by the machine, clearing the way for it. The machine is followed by another man who drills holes about four feet deep at regular intervals in the vein, and in these charges of powder are placed. When the powder is exploded, the coal falls in the room where it has been "undercut" and is ready to be loaded into the cars. It is hoisted in Russell & Parsons self-dumping cages like those already described in use at the Gardner mine. This coal has a lower per cent. of fixed carbon than that of the other mines mentioned; its high per cent. of volatile combustible ingredients was proved to us by the "pit boss" who conducted us about the mine, when he put his little cap lamp to the edge of a drill hole and immediately we saw a strong flame within it.

The screening process here is more complex than at other places. The coal, as it is hoisted, is dumped first upon an inclined screen over which the large blocks pass into a car, and through which the finer bits fall. This finer coal is then taken up by a series of buckets on an endless chain in a closed wooden box to the level at which it was first brought by the cage, and here it is passed through a Parker revolving screen which separates what is sold as nut coal from a third quality known as "screenings."

The men who run the coal cutting machines are paid 4 cents a lineal foot and generally earn about $2.50 a day, against the 65 cents a ton or perhaps $1.95 a day of the hand miners; but a man whom I questioned said he preferred the hand work, because he feels that the constant jar of the machine is injurious.

From a geological point of view, this mine is very interesting. Large oval and elliptical concretions are very numerous in the over and underlying strata; those from 1 foot to 18 inches in diameter are common. One I saw in the mine is between 3 and 4 feet in diameter and is estimated to weigh more than a ton.

Some lying on the ground at the base of the "mud dump" were broken open and show in the center crystals of calcite or aragonite with radiating veins of the same mineral. Among the disintegrating slaty shale, there are quantities of the casts of brachiopods, large and small, but mainly square shouldered, the shape of the shell is outlined in iridescent colors, plainly the work of iron sulphide. These fossils were all that I found at this the newest mine in the field and the only one at which the upper vein is worked. From the lower vein worked at Gardner, Braceville, the old Clarke City mine and others, I have a fine specimen of the cast, in sandstone, of a sigillaria a foot long, and beautiful ferns of many varieties as well as calamites and lepidodendrons are found. The State cabinet contains a portion of the remains of a mastodon taken out near the county seat about the time coal was first mined in the district.

The evidences of the drift period are unmistakable in small bowlders of granite, gneiss, quartzite and trap lying in the fields. The coarse gravel of the river beds consists of fragments of Niagara limestone, which formation constitutes the valuable quarries at Joliet. The deep alluvial deposits throughout the district are striking evidence that it once formed the border of Lake Michigan.

The miners here are of many nationalities. The most intelligent are Welsh, Scotch and English. Side by side with them work Italians, Belgians, Poles, Swedes and Norwegians. It is always a changing company, but none, on the whole, show better staying qualities than the Italians. The men who let liquor alone have comfortable homes, in their own or the company's houses. Their working hours are from 7 in the morning to 5:30 in the afternoon. Only a few watchmen are on duty at night.

Work stops for a half hour at noon, when the miners take their dinner. Some of the pails were opened for my inspection; they are made in two compartments. In the lower part was a bowl of coffee, and above were generous meat sandwiches, pie and cake. At once I contrasted this comfortable fare with that of the Belgian miners which I saw last summer. There the men take in a single tartine for their noonday meal; it is about the size of a Vienna roll.

This is the first summer for three years, and only the second in eight years, that there has been no general strike in this field, where about a third of the 32,000 coal miners of the State are employed. It would seem that at last even the leaders have found out that more distress results from three or four months of idleness than from any other condition; for the fact is the men are working now for less than at any time when they have struck. It is interesting to learn that after all the strikes the men in the employ of the Gardner-Wilmington Company have been the first to resume work.

The decrease in the amount of coal used for manufacturing and transportation as a result of the financial depression, as well as competition with the Southern fields, where mining is easier, has brought the price of this coal down to a lower figure than ever before. But there are good effects of the hard times. Men's wits have been sharpened, inventive skill has been developed where it had not before been exhibited, and means untried hitherto have been adapted to important ends.

A. DINSMOOR.

Gardner, Illinois, September 9, 1895.

* The following is the series of strata gone through in drilling to this vein of coal and the five thinner veins below:

	Feet.	Inches.
Soil	1	6
Yellow clay	7	..
Coarse blue clay	20	6
Slit	1	6
Hard pan	18	6
Calcareous sandstone	35	7
Soapstone (shale)	13	..
Black slate	8	8
Coal (vein worked)	4	8
Fire clay	6	1
Coal	2	..
Slate	5	..
Sandstone	..	8
Coal	1	8
Fire clay	2	..
Soapstone	12	..
Slate and coal	1	..
Fire clay	6	..
Soapstone	1	..
Coal	3	1

AN OAK SEEDLING.

By SOPHIA ARMITT.

THE autumn of 1893 brought an unusual number of acorns in the woods round Harrogate, as elsewhere in England; the ground under the trees was covered and

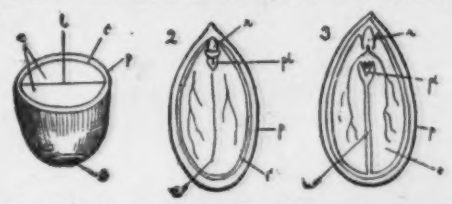


FIG. 1.—Sections of acorns in three places, at right angles to one another. 1, transverse; 2, longitudinal in the plane of the cotyledons; 3, across the plane of the cotyledons; c, cotyledons; t, testa; p, pericarp; s, scar; r, radicle; pl, plumule. The embryonic tissue is at r and pl. The dots in 1 and the veins in 2 and 3 are the vascular bundles. (Copied.)

concealed by them. In the lake country, further north, they were not quite so numerous, but still much more abundant than I had known them before. I had been reading, about that time, some pleasant little books of Mrs. Brightwen's, "Wild Nature Won by Kindness," and "More about Wild Nature," wherein she tells that she had acorns and beech mast collected for the winter feeding of the many wild birds she enticed to her garden and windows, by supplying them with suitable food. There was little or no beech mast that year, even for the squirrels that haunted the beech trees and raced round the house from the trees on one side to those on the other, sometimes taking a peep in at the windows as they passed. I gathered together a pile of acorns and stored them for similar use. I don't know how Mrs. Brightwen managed, but no birds ever

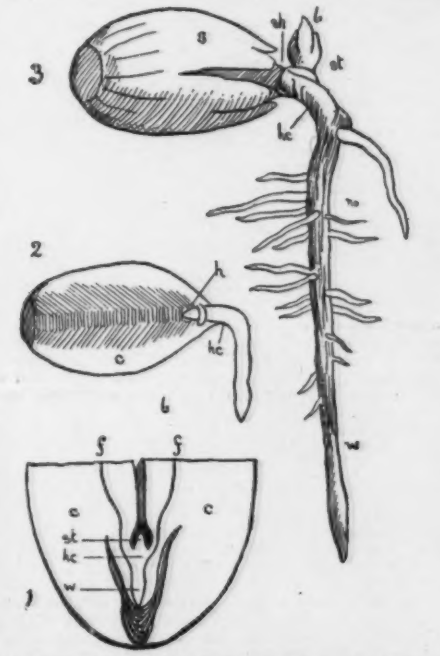


FIG. 2.—1, section of half of embryo; 2, germinating embryo with one cotyledon removed; 3, advanced stage of germination; s, pericarp; sh, testa; b, plumule; st, petiole of cotyledon; hc, hypocotyl; c, cotyledons; f, vascular bundle; w, primary root. (After Lachs.)

came to my acorns, the rooks even did not take them; yet we have successfully fed many small birds through many winters; robins, chaffinches, hedge sparrows, blackbirds, blue titmice, great tits, cole tits, and even once a marsh titmouse. There have always been certain birds in sight of the windows that have never been tempted by human offerings, the tiny wrens that search the outside crevices of the window frames for spiders, and sleep in the veranda nooks, will not notice bread, or fat, or grain. Thrushes, too, will turn over leaves under laurels within sight of the window in search of food, without approaching further. This has always puzzled me, as in towns thrushes are comparatively tame, and will often feed upon scattered crumbs with other birds. There are the long tailed tits and the bullfinches and others, but I am running on too long about the birds. I must apologize and return to the acorns which the birds would not accept.

As I picked up the acorns I noticed that some had already split their shells and that a tiny radicle was emerging. When I turned over the pile later on to throw some to the birds, I found that many of the lower ones had sprouted and sent out radicles an inch, two inches, and some even six inches long. This was rather surprising, as I had thought that these large fruits lay dormant all winter, while necessary changes took place in their stored-up food stuffs, but here were many acorns with long protruded radicles, some two months after my picking them up from under their parent tree. I thought this a good occasion to watch the unfolding embryo life of a great tree, and placed some of the finest of the germinated acorns in the little acorn glasses that are like miniature hyacinth glasses, with the young root in water, and placed them in a sunny window. So situated, I watched their development with interest for nearly a year. The books certainly say that in a state of nature the acorns lie on the ground among the fallen leaves during winter without any apparent change. That they may even lie so for nearly a year, that they require a period of rest before the oxygen of the air and the moisture of the soil are effective in making them germinate, that some molecular or chemical changes must take place in the living cells before further activity, is possible. It has been supposed that until certain ferments have been prepared in the cells, the protoplasm is unable to make use of the stored-up food materials, and therefore to initiate the changes necessary for growth. Then, it is usually said, as the temperature rises in the spring, the embryo in the seed absorbs water and oxygen and swells, the radicle drives its tip through the ruptured investments of the seed, and turning downward, plunges into the

FIG. 3.—Germinating acorn, showing the manner of emergence of the primary shoot and the first scalps. (After Rossmaessler.)

soil. This must, of course, be the case usually, but in the autumn of 1893, things went a little differently; perhaps the unusually hot summer had abbreviated the normal course. Be this as it may, early in November I gathered acorns already sprouting, and in December about half of the piled-up acorns in a shady corner of the veranda, without any spring warmth, without any moisture, and without any soil to penetrate, had already long radicles, and the finest of them, set to grow in the glasses, throve well all through the summer of 1894, till the end of October, when inexorable circumstances parted me from them.

Many of the acorns of 1893 were of unusual size, quite an inch long, and proportionately broad. They fell, some with and some without the cup or cupule, which is no part of the fruit itself, but only a mass of hardened bracts of the floral envelope. The acorn is a polished dark brown or leather colored, egg shaped fruit. Its broad flat end that lies in the cup is marked by a large round scar, the remains of the attachment of acorn and cup; the scar is rough from the breakage of the little pipes or vessels which traversed the cupules from the stem to the fruit. The free end of the acorn is pointed with a little knob, the remains of the stigma of the past and gone flower of spring. The polished hard coat of the acorn, marked with fine longitudinal lines, is the covering of the fruit, the pericarp; inside this is a papery membrane, the inner pericarp. In the ripe fruit both are dead structures, existing as protecting coverings to the seed within, which is now loose and free from them. On shaking it may be heard to rattle about; it was at first attached by the broad end by the same connecting pipes that ran through the cup from the twig. The pipes too are shriveled and dead and broken across, their use being past. The seed is not much smaller than the fruit which it fills up loosely, of the same shape, and covered with brown papery membrane, its own coat or testa. It is horny and hard, and is made up of two halves lying closely pressed together, face to face, from the top of the acorn to the bottom. These two halves or cotyledons are not quite separate or free from each other; they are united to a tiny body lying embedded and pressed between them at the pointed end of the seed, a body that is of itself so small that it is easily overlooked. The larger end of this small embryo is the radicle pointing upward to the apex of the acorn; the smaller end turned down is the plumule, the origin of the stem and leaves of the oak, as the radicle is the origin of its root system. Each cotyledon is united to the tiny embryo by a minute stalk. Thus the testa of the large seed is filled up by two immense cotyledons, a tiny radicle and a tinier plumule, the tip of the radicle lying just inside the membrane covering the seed and pointing outward.

Thin sections of this seed placed under the microscope display polygonal cells of thin walls tightly packed with granule-like contents. The whole embryo consists almost entirely of this fundamental tissue. Surrounding the embryo and following all its shape is

a layer of flattened cells fitting close round it as a glove, and this is the outer layer of the young plant, the epidermis. Where the sections are cut across the cotyledons, or radicle, or plumule, there are seen certain minute specks, the cut surfaces of fine cords of long and narrow cells, which are the vascular bundles. One set of them runs up the center of the radicle, starting from its tip; they pass into the cotyledons, there branch and run to the remoter parts. The cells of the fundamental tissues of the cotyledons are packed with starch grains of oval shape and pearly luster, lying embedded in proteids and tannin, with some little fatty substance. The starch grains are stores of food containing carbon, hydrogen and oxygen; the proteids contain nitrogen and certain mineral salts. The vascular bundles are the pipes along which this stored-up food will travel to the radicle and plumule, as soon as germination begins. The young epidermis has no part in the storing or conducting of food material; it is simply a covering, and will extend with the growth of the young plant inside it. When the swelling seed splits its hard investments, the little radicle lengthens and comes out first, turning downward and entering the soil slowly; it wants to get firm hold of the ground and to absorb water. The cotyledons remain in the acorn, and the developing root draws its growing material from their richly stored cells. They nourish the young plant for months, and may even not be entirely exhausted at the end of two years. The cotyledons play a threefold part; they are storehouses of food, they are protective to the rudimentary tree pressed closely between them, they also perform the task of thrusting out of the seed case the tiny plant germ, that its members may elongate in the two directions. The last two duties are much more quickly performed than the first. In my young oaklings of six to eight inches high, grown in water, the cotyledons were still in the seed case. I have a young oak pressed in its second year of growth with the cotyledons erect and separate. I suppose the inclosing case simply rotted away during the winter, and so set them free. They are a good deal shrunk, but still much thicker than a foliage leaf. Eventually they get entirely emptied out, die off and disintegrate, so that the place of their connection with the stem can scarcely be discovered. The germination of the beech, which I have often watched, is very different. The cotyledons, though thick and fleshy, are folded up tightly like a fan; they are drawn out of their nut-like covering very early, and then expand and rise till they are thick but flat and green leaves, as oak cotyledons never seem to be.

When the radicle of the oak is some two to three inches long, the plumule comes out from between the stalks of the cotyledons, which elongate and separate to permit its passage, and begins its growth up into air and light; this plumule, too, lives on the stored-up food stuffs of the cotyledons, the dissolved substances are conveyed into it by the small pipes or vascular bundles arranged for that purpose. As the radicle starts into growth before the plumule, so it keeps ahead of it, being always longer and stouter than the young shoot in air, and beset with side strands or rootlets. At first the young oakling is without leaves, bearing only a few scales; when it is about three inches high, there are two scales close to the top that are a little longer than those that are below, and from between the scales comes the first leaf, a small green leaf of no very decided shape. Then the stem elongates and throws out other leaves that are distinctly oak leaves in contour. At the end of summer there are five or six leaves, shortly stalked, each between its pair of stipules. A line drawn round this young stem joining the points of leaf insertion describes a spiral, which circles twice round the stem and arrives at the sixth leaf immediately over the first one.

The root of one of my little oaks was infested with a curious and, I suppose, a fungoid growth. In appearance it was something like the barnacles of the sea, bluntly conical protuberances along the crack-like markings on the stoutest part of the root; filmy slime seemed to come off from the protuberances and thicken the water. A young oak of the same size that I dug out from its native soil bore the same parasite, but in much less degree. I was much interested, but unable to investigate these further. Perhaps some of your readers may be able to tell us something about this parasite.

As I have already indicated, the observation of the growth of plants from their seeds will be found not only most interesting but in the case of the larger seeds, such as walnut, oak, beech and others, comparatively easy to manage.—Science Gossip.

WIND FERTILIZED FLOWERS.

By the Rev. ALEX. S. WILSON, M.A., B.Sc.

As an agent in cross fertilization, the wind performs an indispensable service to many plants. Flowers which depend on its agency for the transport of their pollen are termed anemophilous; those adapted to insects, entomophilous. Wind fertilized blossoms are all of small size, obscurely colored and, even when clustered together in catkins, inconspicuous; hence they escape observation more readily than their entomophilous neighbors, which are adorned with bright colors to allure visitors. Although anemophilous flowers do not exhibit the variety of curious contrivances found in the entomophilous class, they yet present a number of highly interesting characters and are well worthy of examination. Wind fertilization is universal in the lower or gymnospermous division of flowering plants, of which we have examples in the pine, larch, cedar, and other coniferous trees. The apetalous dicotyledons or Incompletæ form another large group in which wind fertilization prevails extensively. In this sub-class are included the various species of dock, sorrel, nettle, pellitory of the wall, dog's mercury, goosefoot, boxwood, hop, mulberry, elm and catkin bearing trees, such as the oak, hazel, beech, poplar, birch, alder, walnut and willow, all of which are wind fertilized. Anemophily is not so common in dicotyledons belonging to the other sub-classes; it occurs, however, in the ash, plantain, wormwood, mare's tail and meadow rue. The number of wind fertilized monocotyledons far exceeds those adapted to insects, both as regards individuals and species. The extensive order of grasses, the sedges, carices and rushes, together with the arrowhead, arrow-grass, bur reed and bulrush, are all without exception anemophilous. It thus appears that wind fertilization occurs in many different and widely separated families. Certain negative characters are common to all the wind fertilized class; no honey is secreted, no perfume emitted, and conspicuous colors are wanting. On flowers of this description it is difficult for a large

FIG. 1.—Catkins of wind fertilized flowers. A, willow; B, poplar. (Dioecious.)

insect like a bee to obtain a footing; there is no corolla that can serve as a landing stage for insects to alight. For these reasons anemophilous blossoms are almost entirely neglected by bees and other flower haunting insects; only in exceptional instances do visitors have recourse to them in search of pollen, but this is so dry and has so little cohesion that it must be difficult indeed for a bee to collect an appreciable

FIG. 2.—Pollen grains of insect and wind fertilized flowers. 1, coltsfoot; 2, abutilon; 3, wolf's bane (insect fertilized); 4, hazel; 5, ash; 6, plantago; 7, grass; 8, pine (wind fertilized).

quantity of anemophilous pollen. Wind fertilized flowers thus offer little or no attraction to insects, and are in no way adapted to derive benefit from their visits. On the other hand, there exist in them a number of provisions which admirably adapt them for cross fertilization through atmospheric agency. The most important of these is abundant pollen; always more than in insect fertilized blossoms, the quantity

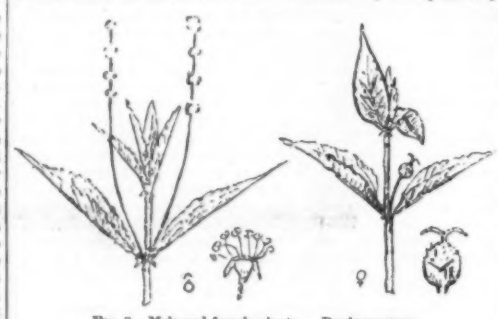


FIG. 3.—Male and female plants. Dog's mercury.

produced by some plants of the wind fertilized class is enormous. The so-called showers of sulphur, occasionally reported in the newspapers, are really great deposits of pollen blown from the male cones of the Scotch fir. It has been known to fall on ships at sea, and has been swept up in bucketfuls from their decks. The common ash discharges an immense quantity from its innumerable flowers, so much so that a person shaking a branch when the tree is in bloom is dusted from head to foot with the dry powdery pollen. That of the elm is also very abundant, and this is more or less characteristic of all plants which depend for cross fertilization on the wind. At certain seasons the air may be said to be literally charged with the pollen of anemophilous plants. In the beginning of May I exposed on the window sill, for forty-eight

FIG. 4.—Inflorescence of the quaking grass.

FIG. 5.—Unisexual flowers of nettle.

hours, a microscopic slide smeared with sirup, and on examining it afterward detected upward of fifty pollen grains belonging to various trees, some of which are not to be found within a radius of two miles. The efficiency of the wind as a fertilizing agent is, therefore, much greater than one might suppose.

The pollen grains of insect fertilized flowers are frequently, as in the harebell, coltsfoot and mallow, studded over with little projecting points; these cause them to adhere readily to each other or to the hairs of an insect. In other cases the pollen is viscid, and the granules are difficult to separate. This cohesive character obviously renders them ill adapted for transference by means of the wind; accordingly the pollen of wind fertilized plants is excessively light and dry, the granules are smooth, they do not stick together, and this incoherence facilitates their wide dispersion. A special provision exists in the pine, whereby its pollen is rendered lighter and more easily wafted by the wind; the extine or outer membrane of each granule

FIG. 6.—Anemophilous flowers. A, oat; B, arrowgrass.

is inflated into two globular air sacs, which reduce its specific gravity so that it can keep longer afloat in the air.

Although there are wind fertilized species to be found in bloom almost all the year round, a large number, especially of trees, blossom early in the season; the hazel comes into bloom in February, the elm, poplar and willow following in March or April. The little flowers of the willow are already developed within the bud at the beginning of winter; in spring they merely expand. It is, therefore, probable that trees of this class originally flowered toward the end of the year, but ultimately became so belated that the opening of their flowers had to be delayed over winter. During the dry, windy days of spring, when the farmer sows his seed corn, the flowers of our anemophilous trees are in perfection. At this early period, when so few insects are abroad, these unattractive blossoms are not likely to be favored with their visits.

A marked peculiarity of anemophilous trees is the appearance of the flowers before the foliage; the blossoms of the elm, poplar, ash and willow, for example, are put forth while as yet the branches are entirely leafless. This arrangement is clearly advantageous; the foliage would protect the flowers from the wind, preventing it from gaining access to the stigmas and interfering with the removal of the pollen.

The fir does not shed its leaves in autumn as deciduous trees do, but its needle-like foliage interferes as

FIG. 7.—Dichogamy of the rush.

FIG. 8.—Head of Plantago lanceolata in two stages.

little as possible in the way indicated; nevertheless, the male and female cones are developed on the branches of the fir in the most exposed positions. A good illustration of the manner in which wind fertilized plants secure the exposure of their blossoms is seen in the dog's mercury (Mercurialis perennis). This plant, common in most districts, has rather large leaves; they expand before the flowers, and would be a great hindrance to wind fertilization were it not that the little staminate flowers are elevated on long, slender stalks which spring from the axils of the leaves and entirely overtop the foliage. The male catkin of the oak is an inflorescence of the same description, not erect, however, but pendulous, and so flexible that it swings freely in the lightest breeze. After the flowering period, the ground under the oak, poplar, and other trees, is strewn with their male catkins; these are caducous, falling off soon after they have shed their pollen; the catkins of female flowers are necessarily persistent, though a few may occasionally be broken off by the violence of the wind.

In reeds and grasses the entire plant, being flexible, is easily shaken by the wind, and the ripe pollen is readily dislodged from the anthers; but where the stem is more rigid either the flower stalks are slender or the stamens have thin, thread-like filaments; or the

FIG. 9.—Flower of plantago in two stages, showing protogyny.

FIG. 10.—Bur reed (monoecious and protogynous.)

entire inflorescence is mobile; in any case provision is made in the structure of the flower for the agitation of the anthers by the wind. Slender flower stalks are seen in the dock and in the quaking grass (Briza). The ribwort plantain (Plantago lanceolata) and a great many grasses have their anthers borne on long, excessively thin stalks, so that they quiver in the slightest breeze. Broad and leaf shaped, the anther itself in plantago is clearly adapted, like the seed vessels of some crucifers, to be set in motion by the wind.

On a calm and warm day in summer the gentlest touch is sufficient to make many grasses, such as the foxtail, cock's foot or timothy, emit a little cloud of pollen. Some grasses even appear to eject the pollen with force either by the explosion of the pollen sacs or by a sudden jerking of the stamens. The nettle and pellitory have each four elastic stamens; when the flower opens, these are bent inward toward the center in a constrained position; later on, the tension is removed and the liberated stamens suddenly straighten out, scattering their pollen like little puffs of smoke. The object of this Liliputian artillery is to throw the pollen away quite clear of the plant by which it was produced.

Petals in ordinary flowers are intended to secure the attention of insects; to wind fertilized blossoms, having no occasion for visitors, they are unnecessary. So far from an advantage, the presence of a corolla would exclude the wind from the essential organs. Accordingly petals are either absent altogether or reduced to rudimentary proportions. The calyx is also much reduced, and in some flowers is dispensed with entirely. Comparatively few anemophilous flowers possess both sets of floral envelopes. Plantago is, however, dichlamydeous, but its chaffy petals afford incontrovertible evidence of degeneration from the entomophilous condition.

The stigma in the wind fertilized class is highly specialized, and much larger relatively to the other parts of the flower than is the case with entomophilous blossoms. It is commonly penicillate, consisting of a tuft of hairs as in the nettle; feathery, as in grasses; or elongated and thread like, as in plantago and the rushes. The spirally twisted stigmas of the last mentioned flowers are beautiful objects when examined with a pocket lens. The larger the surface which the stigma presents to the wind, the greater are the chances of pollination. Its fine fringes of papillose hairs are also well calculated to entangle the pollen grains, while the viscid secretion serves to retain them when caught. This adaptation may be seen in the common rye grass; each tiny blossom as it expands hangs out its two white, feathery stigmas from the sides of the spikelet, reminding one of a fisherman spreading out his nets, or a sailor his studding sails to catch the favoring breeze. At the time of fertilization the dock, too, thrusts out its three little brush-like stigmas between the lobes of the perianth. It is instructive to compare these wind fertilized flowers of Rumex with those of the nearly allied genus polygonum, which is entomophilous. The perianth of the latter is rose colored; the stigmas are included within it, never exserted, as in the dock—they are not at all brush-like or feathery, but in the form of little knobs; the stamens and flower stalks are rigid; moreover, the various species of polygonum secrete nectar and are frequented by many different insects. Stigmas are entirely absent in the gymnospermous division, but in most Coniferæ the ovule at the time of flowering secretes a drop of fluid, and the pollen grains caught on it are, as the fluid gradually evaporates, stranded on the nucleus of the ovule. The ovule of the larch is provided with elongated papillæ, functionally equivalent to a stigma.

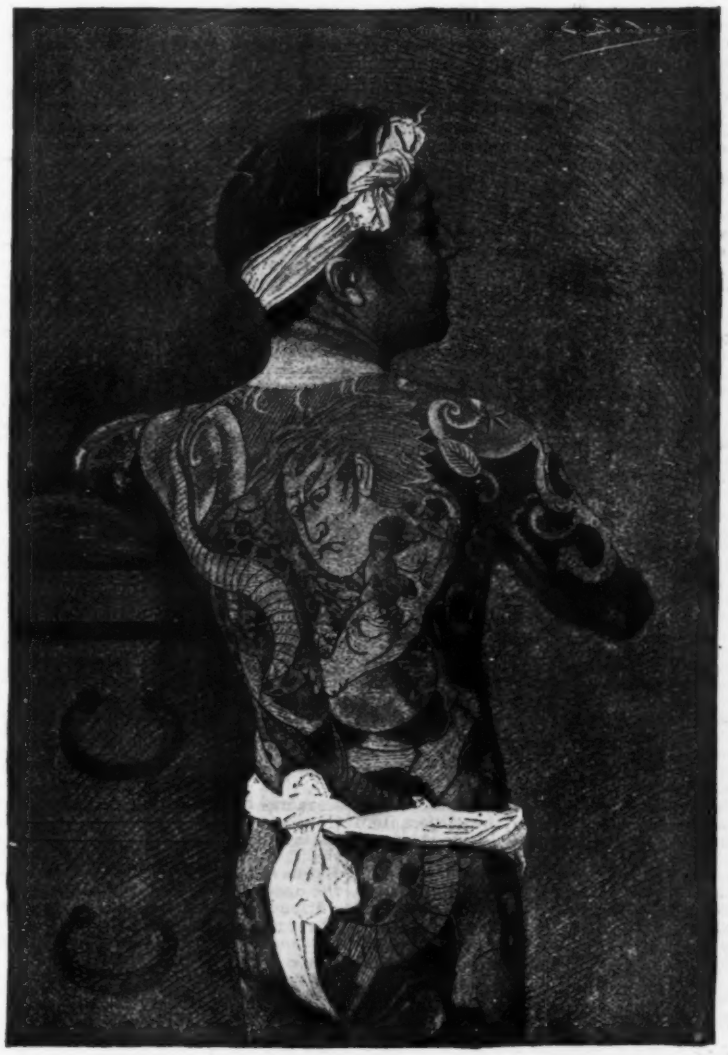
A flower is said to be hermaphrodite or monoclinous when, as in the elm, both stamens and pistils are present in the same blossom. With insect fertilized flowers this is mostly the case, though there are some exceptions, such as the cucumber and begonia, which are unisexual or diclinous, stamens and pistils being produced in separate blossoms. The diclinous condition is exceedingly common in the wind fertilized class. The staminate or male and the pistillate or female flowers are sometimes found growing on the same individual plant, which is then termed monœcious, as in the oak, hazel, birch, pine, etc. The poplar, willow, yew, juniper, nettle and dog's mercury, on the other hand, are diœcious; their staminate and pistillate flowers grow on separate plants. This separation of the sexes renders self-fertilization impossible, and secures whatever benefit may arise from the physiological division of labor. Anemophilous species in general show a marked tendency in the direction of separation. Self-fertilization may be prevented in monoclinous flowers by the stamens and stigmas maturing at different times. This arrangement, known as dichogamy, occurs both in insect and wind fertilized blossoms, but while the former usually have the stamens in advance of the stigmas, in the latter the reverse order is much more frequent. There are thus two kinds of dichogamy—protandrous, where the stamens are in advance; protogynous, if the pistils are first developed. Protogyny is characteristic of wind fertilized flowers, and may easily be observed in the rush and plantain. From the illustration it will be seen that, in the first or female stage of the flower of the rush, the thread-like stigma protrudes from the top of the still unopened perianth, while the stamens, as yet immature, are completely concealed. In the second stage the pollinated stigmas have begun to shrivel, the perianth has now spread out, disclosing the six stamens, which are ready to discharge their pollen. The same two stages are equally apparent in plantago. All our readers must be familiar with the black heads of this plant, which are to be seen on every pasture, bending and waving in the wind. In the first stage the head appears black, but on looking into it we see projecting from each little unopened floret a white, thread-like stigma. Later on, the lower part of the spike or head is seen to be encircled by a wreath of tiny white bodies, and closer inspection shows that these are the stamens, four of which project like little banners from each of the newly opened florets. The protogynous character belongs in the bur reed to the plant itself, rather than the individual flowers. Its pistillate flowers, which are lowermost, expand first; only when their stigmas have withered do the male florets higher up begin discharging their pollen. In this case it is evident that the flowers on any plant must be fertilized with pollen from another in a more advanced condition. A social habit is highly characteristic of wind fertilized plants—pines, grasses, sedges, nettles, etc., usually grow together in considerable numbers. Entomophilous plants have a much more sporadic character, and admit of a greater degree of isolation; their guests, doubtless, maintain the necessary communication between members of the species. This social habit partly explains the tendency toward the diœcious condition, for a complete separation of the sexes is hardly possible, except in plants of social habit. From the gymnosperms, the oldest flowering plants, being all wind fertilized, it has been inferred that such must also have been the case with the primitive angiosperms. It is not certain, however, that any of their representatives remain, for many of our existing wind fertilized flowers appear to be merely degraded forms. Anemophilous species occur in families, the rest of which are highly specialized in relation to insects. Some species of plantago are adapted to insects; others, as we have seen, to the wind. Most of the sub-class with incomplete flowers, from which so many of our examples are taken, also exhibit striking marks of degeneration, and the same may be said of the grasses and other anemophilous monocotyledons. We also find some flowers in an intermediate condition, such as the vine and certain willows, which secrete honey and are visited by insects. Facts of this description are held by some to show that all existing anemophilous species, with the exception of the gymnosperms, are descended from bright colored, insect fertilized ancestors.

Wind fertilization has, in some instances, been rendered highly efficient, but in any case it is far from economical, for the vast amount of pollen miscarried represents an enormous loss to plants; neither does this method admit of the same certainty and precision as the other. A wind fertilized bears to an insect fertilized blossom very much the relation which an Æolian harp bears to a pianoforte.—Knowledge.

THE ART AND MYSTERY OF TATTOOING.

By TIGHE HOPKINS.

THE "ancient and fantastic" habit of tattooing is common to all the races of men. It is co-extensive with the limits of the world, and coeval with human history. From the polar regions to the farthest islands of the south the practice has prevailed, and from the first recorded epoch. It flourishes still in "strands afar remote," it exists to a lesser extent in all European countries, and it is nowhere quite extinct.



TATTOOING IN JAPAN.

ANCIENT PRACTICE.

There are constant references to the subject in classic writings. Slaves and captives taken in war were graven with marks or pictorial emblems in various parts of the body; soldiers, certain workmen and criminals were similarly treated, and "the followers of several divinities" habitually tattooed themselves.

Religion and fetishism have influenced the practice in many countries and among peoples differing from one another in most other accustomed practices. Moses forbade it expressly to the Hebrews: "Ye shall not make any cuttings in your flesh for the dead, nor print any marks upon you." Mohammed seems to forbid it in the Koran, but many Arabs frequent the tattooer, and his art is in great honor among the Kabyles of the desert. These and the Mohammedan negroes who follow the usage say that before entering Paradise they undergo a purification by fire, which cleanses them of all terrestrian and idolatrous marks.

The early Christians were frequently graven with a cross in the palm of the hand or on the arm. A council of the Fathers banned the custom; but it was not easily abolished, and a French author says that pilgrims and visitors to the Holy Land were often tattooed on the wrist or arm "with signs representing the cross or the monogram of Christ."

A seventeenth century traveler, Thévenot, quoted by Dr. Lacassagne ("Les Tatouages: Etude Anthropologique et Médico-Legale") has the following allusion: "We spent the whole of Thursday getting our arms marked after the pilgrims' fashion. The Christians at Bethlehem do it according to the Latin rite." The Grand Duke Nicholas, of Russia, is said to have had his arm tattooed at Jerusalem. Lombroso (in the remarkable chapter on tattooing in "L'Uomo Delinquente," of which I use the French translation) says it is a frequent habit after pilgrimages in Italy, and he has observed a great number of religious emblems tattooed on persons who have visited the sanctuary of Loretto. In various towns both in Italy and in France professional tattooers haunt the neighborhood of certain churches and press their services upon those who enter. This must have been to some extent a religious usage of the ancient Egyptians, for pointing and cutting instruments recognized as belonging to the tattooer have been found in the oldest tombs.

Before enlarging on the subject it will be well to get a definition. That of Dr. Berchon ("Histoire Médicale du Tatouage") is not easily improved upon. Tattooing, then, according to this authority, is the process by which certain coloring matters, vegetable or mineral, are introduced beneath the skin, at various depths, for the purpose of producing a colored design, which endures long, but is not absolutely indelible. The word "tattoo" is from the Tahitian verb Tatup, and contains the idea of the sound—tat, tat, tat—given out by one of the tattooer's implements.

DIVERS METHODS.

There are various modes of performing the operation, which, as Lombroso justly observes, is rather surgical than æsthetic. Its ethnological tradition is shown to have come down to us from far past ages, and it is easily traced from the period of the downfall of the Roman Empire. The divers methods of the ancients, says Berchon, are perpetuated in almost every race, and have been recognized most particularly in Oceania, where the Marquesans, the Tahitians and, in general, the tribes of the yellow Polynesians, still use by preference the practice of tattooing by puncture or pricking, while the dark hued Oceanians join with that the tattooing by cutting or incision. In some of the South Sea islands and in some of the Asiatic isles there are varieties of the operation which recall the more or less illegitimate tattooing by burning, where the instrument employed is fired to a red heat. The black race in Africa, particularly, has recourse to a

cutting process, afterward rubbing into the wound an irritating substance, which causes a ridge or protuberance. Sometimes the instrument used is a red hot knife, but this is not tattooing proper.

In European countries at this day there is probably no other method than that by puncture or pricking with needles. This is, at all events, by far the commonest process. Berchon says that a form of burning may be used occasionally (he does not, I think, cite an instance), a small quantity of gunpowder being disposed with art on the spot where the design is to be traced, and carefully exploded.

Ordinary needles of various sizes are used. These, to the number of three or five, are fastened with threads between two small pieces of wood, or inserted in a small cork, the points of the needles being on a level. The design, of whatever nature, may be pricked out directly with this instrument, or the operator may trace it first upon the skin—which should be stretched as tightly as possible—with pen or pencil. Some tattooers have their designs pricked on paper, which is used as a sort of sieve, the coloring matter being shaken through the holes, after which the needles are brought into play. Occasionally, says Berchon, the tattooers "have models of designs, fashioned in wood garnished with sharp points, which are driven into the skin in such a manner that the operation is performed at a single stroke." This method, he adds, is very rare.

The needles are inserted perpendicularly or in a slightly oblique direction, and during the operation they must be dipped from moment to moment in the liquid which holds the coloring matter. The designs, simple or elaborate, take but a very short time to complete under the fingers of a skillful operator. Lacassagne has seen "fairly complicated patterns executed in half an hour."

PROFESSIONAL TATTOOING.

In Paris, Lyons, and other large towns of France, says the same author, there are professional tattooers, who live entirely by their calling. They have little studios of their own, or they haunt the wine shops, and go about to fairs and fetes. Their clients have the choice of a number of designs which the tattooers keep in albums, and of which the price is ordinarily fifty centimes. Sixty to seventy five centimes, says Lombroso, is the sum demanded of the poorer class of pilgrims to Loretto; "large enough, when one thinks of the possible consequences of the operation"—erysipelas, gangrene, amputation, sometimes death itself. Lacassagne has noted the general use, among French tattooers, of designs traced on glazed paper. The principal outlines are pricked with a pin, and when the paper is laid upon the part to be tattooed it is smeared over with lampblack. The needle then works over the impression thus taken. On the other hand, when the tattooer is something of an artist with the pen, he traces his own original design upon the skin, and then punctures it.

Fame comes slowly to tattooers in western countries, where, on the whole, the art is but little honored, and no tattooer's name has been widely bruited. Lacassagne has mention of an anonymous Irishman in New York, who was much reputed among the sailors, both for the excellence of his work and for the rapidity with which he did it. One of the French sailors examined by Lacassagne displayed on his back a large picture of an Indian holding up the flag of America, which he said the Irishman had tattooed upon him in five and twenty minutes. It had cost him the equivalent of fifteen francs. The Irishman gained his living as a tattooer, frequenting the sailors' haunts, and sometimes earned as much as five pounds in a day.

COLORING MATTER.

The coloring matters employed by the modern tattooer in European countries are not very numerous. Probably they were not very numerous at any time. Some are considered to be more dangerous than others, but Berchon makes rather light of this point. There are possible dangers connected with the introduction of any and every foreign substance beneath the skin, and there is a tradition among tattooers that vermilion (which also, by the way, fades the soonest) causes, or may cause, more hurt to the subject than the other coloring substances ordinarily made use of. Among these other substances Lacassagne names China ink, powdered charcoal, finely powdered brick dust, coal dust, Prussian blue, washing blue, lampblack, and ordinary writing ink. Among the ancients the coloring matter seems to have been always, or nearly always, black; the precise nature of the substance remains doubtful. Various colors may be combined in one design, but red and black and varying shades of blue (whatever be the actual coloring matter) are the dominants. Berchon inclines to the opinion that, although there is danger in all the coloring substances which the tattooer has recourse to, no one of those in ordinary use in Europe is greatly more dangerous than another. This aspect of the question will be discussed later on, and for the present it will be sufficient to suggest that the instruments employed, the nature and quality of the coloring matter, the condition of health of the person tattooed, the fineness of the skin, the activity of the circulation, and the richness or poverty of the blood should all be taken account of.

A PROTRACTED CEREMONY.

Naturally, the risks incurred increase in proportion to the size of the design, and in savage countries, where it is the custom to tattoo the whole or the greater portion of the body, the utmost care is taken of the patient while the operation is in progress. The first effect is a lively irritation of the punctured surface. It becomes hot, red, and inflamed, and often swells abnormally. These effects may pass very quickly, and if graver consequences do not ensue, the patient is in a short time thoroughly healed.

As to the sufferings endured (usually with a fine heroism) by savages under the hands of the tattooer, we have the testimony of innumerable travelers. Very often the process has to be suspended for weeks, or even for months, to allow the youth to get the better of his wounds: and in some countries the warriors are not completely tattooed until long after middle age. The process is of cardinal importance, generally invested with a certain mystery and performed with a certain secrecy, by a tattooer whose art has been passed on to him by his father and his father's father. Princely families retain their own tattooer—a master of his calling, holding a hereditary office; and if, owing to the death of his immediate predecessor, the office has fallen to him before his hand has attained its proper cunning, the royal clients whose "cutaneous envelope" he is destined to illustrate will defer their tattooing for a period. In tribes (not numerous) in which it is customary for the women to be elaborately tattooed, a human victim is sometimes sacrificed to celebrate the "finished decoration" of a princess. In other tribes, says Westermarck ("History of Human Marriage"), as soon as a young brave has passed from the hands of the tattooer, a great feast is given in his honor, and he is then entitled to offer himself as a suitor to the maiden of his choice.

For a picture of the tattooer at work in these far-off regions we may turn first to the pages of Dumont d'Urville ("Voyage Pittoresque autour du Monde"), who describes a female tattooer in the exercise of her art. The patient was being tattooed on the right cheek, "the left being already covered with these honorable marks." The skin had been smeared with a black preparation, on which the tattooer traced her pattern. This done, she took a little instrument, formed of an albatross' bone fastened at right angles to a small bit of wood, like the lancet of a veterinary surgeon, or, better still, a miniature pick ax. The bone was sharpened at the extremity, so that, when the back of the wooden handle was struck with "un petit baton," it laid the skin open with a deep incision. Blood came in abundance, which the operator wiped away with her hand and with a wooden spatula. The coloring matter was then laid in the slit. The patient "must have suffered cruelly," adds the narrator, "but he did not utter so much as a sigh."

Dumont d'Urville finds it possible to praise tattooing as an embellishment of the human countenance. It adds expression and energy, he says, "and strangers accustom themselves easily to this most curious adornment." It saves the features from the disfiguring effects of mosquito bites, it conceals the rude usages of excessive heat, cold, or wet, and the coming on of age. Better than all other outward ornament, moreover, "it reveals in an instant the condition and rank of the wearer."

The natives of New Zealand have always attached great importance to the art of the tattooer, which they call moko. It is forbidden to the women to tattoo their faces, that privilege being reserved to the warriors, each of whom, says Lacassagne, has a moko proper to himself—his armorial bearings in fact. A native who was shown by a European the seal on which his arms were engraved, and to whom the meaning was explained, replied at once, "Ah! it is the moko of your family." After each new victory the warrior engraves an emblem of it on his person; hence the moko comes to play the part of "a veritable figurative writing." To return to the process itself. The instruments in use among the Oceanians include fish bones, bones of birds (sharpened or pointed for their purpose), and the hard thorns of plants. With these is found a little mallet or hammer, where the operation is performed by incision. Several kinds of nuts, bruised and steeped in cocoanut oil, furnish the colors for the designs.

There is no doubt that, despite the fortitude with which it is commonly borne, the protracted ceremony of tattooing is much dreaded by the native Oceanians. We have it on the authority of travelers, says Berchon, that the Polynesian tattooers "had often to hold their patients down by force until the cruel operation was finished." The recitation of a scene witnessed by the naturalist Banks on his voyage with Captain Cook gives confirmation to this statement.

TATTOOING OF WOMEN.

Banks saw a girl of thirteen tattooed on the back. The tattooer used an instrument furnished with thirty teeth, with which he made more than a hundred punctures per minute. For a quarter of an hour the little victim endured her pains with the utmost courage, then she began to cry out, sobbed violently, and screamed to the tattooer to release her. But he continued to ply his instrument, and when the girl began to struggle, called on two women to hold her, by whom she was alternately coaxed, petted, scolded, and beaten. Banks quitted the scene at the end of an hour, when the operation was still unfinished.

In some tribes the women are tattooed as elaborately as the men, but this is not a frequent custom. In general the women of a tribe carry far fewer marks of the tattooer than the other sex. There are tribes in which the men only are tattooed, and in others—this, however, is most exceptional—none but the women undergo the operation. Tylor, "Primitive Culture," discussing legends of tattooing, tells how it came to pass that the Fijians tattoo their women and not their men, and their neighbors, the Tongans, the men and not the women. A Tongan was sent to Fiji to learn how tattooing should be done. The Fijians told him: "The women must be tattooed and not the men." He repeated this saying diligently on his journey home, until he met with some obstacle in his path which nearly occasioned him a fall. At that unlucky instant he forgot the famous phrase, and arrived at Tonga, he announced to his people, "It is the men we must tattoo and not the women." The precept was adopted and applied from that hour. The explanation, says Tylor, seems quite natural to the Polynesians, for the people of Samoa have a story very similar to the one which is traditional in Tonga.

TATTOO AS COSTUME.

Let me summarize now a lengthened and vivid account from the "Lettres sur les iles Marquises." Here the author insists that the smallest and least important details of the rite have a sacred significance, and are carried out either in secret or in some consecrated spot, accompanied by ceremonies which enhance their solemn character. "It was only by special privilege that we, as profane strangers, were permitted on one occasion to witness the operation."

The tattooer, nephew of a celebrated artist in this line, was but fifteen years of age, "a most interesting young man." His patient was couched on a heap of straw, with several friends to comfort or maintain him in the proper attitude. The tattooer had beside him his instruments of bone and cups filled with colored liquids, and began by designing "a thousand dainty figures, lace work, embroideries, and sketches of fishes." These designs outlined on the skin, the artist proceeded to prick them in with his needles. It was very evident from the poor patient's grimaces that there was "quelque chose de piquant" in the operation, which indeed presently drew from him "les soupirs de la douleur," though he uttered never a cry. "After some hours the patient is released, the tattooer having first carefully wiped away every drop of blood. The tattooer receives his customary recompense, and the smarting patient—to whom certain kinds of food are forbidden for several days—goes home, where the lace work that has been pricked on his person becomes so many agonizing ulcers. In a few days' time these ulcers are healed, the laces and embroideries reappear more beautiful than before, and never to be effaced."

The tattooing of the two sexes, the author continues, is by no means the same. The women's ornaments, "those even of the most exalted princesses," are limited to buskins, bracelets, a glove perhaps on one hand, epaulets reaching midway down the arms, and certain markings on the lips and ears. For the men, "c'est autre chose." From the feet upward there is scarcely a portion of the body which is not elaborately decorated; "stockings and buskins of the finest design and the choicest workmanship that I have ever seen;" knees and thighs have their appropriate "covering;" the back is "a veritable medley of tints;" the upper part of the body bears "the most elegant cuirasse;" "nothing is spared to render the design perfect." The hands have their gloves "des gants à jour" mounting half way up the arm, where they are met by the sleeves of the gorget ("hausse-col"). Having costumed his client thus from feet to shoulders, the tattooer finishes off with the face; but here, according to le père Mathias G——, from whom these veracious facts are borrowed, the artistic sense of the designer seems to desert him: for the features are studiously disfigured ("la figure . . . à dessein défigurée") with a sort of crossbar pattern, "so painfully grotesque as to inspire both fear and disgust." The "motif" of the disfiguration of the face is to weaken the courage of the enemy in battle. "Sauf cette horrible caricature" of the features, concludes the reverend author, you might easily mistake the handiwork of the tattooer for the finest imaginable coat of mail of an old time cavalier; and when the native warrior is thus appareled, nudity parts company with impropriety, and the "costume" is readily acquiesced in as proper at once to the climate and to the tastes of "this warlike people."

PATHOLOGY OF THE ART.

The author of "Les Derniers Sauvages" furnishes another description of the mode adopted in the Marquesas. The man whose skin was being figured rested with his head between the knees of another, the upper portion of his body bent backward. The tattooer, kneeling beside him, drove in with a small hammer the fine points of the "comb," which he soaked from time to time in the coloring matter. The comb traveled first between the patient's temples, describing on the forehead "une auréole sanglante." A second line traversed the face in a horizontal direction. These two lines (the regularity of which, despite the convulsive movements of the patient's head and the smallness of the tattooing comb, was perfect) formed the boundaries of a series of oblique "hatchings," very close together, which in all were but the beginnings of a broad band or fillet designed to enlarge and enhance the brilliancy of the eyes.

The contraction of the patient's features, the nervous movements of his limbs, and his continuous moans showed, says the narrator, at what a cost of suffering he procured for himself that "strange and indelible" badge of his people. And he remarks further that "the operation ends, sooner or later, by overcoming the most stoical powers of endurance. It is suspended then, and weeks or whole months elapse before it is resumed." Nor does the suffering end with the first sharp pains produced by the teeth of the comb. Erysipelas, accompanied by shooting pains, causes the whole lacerated area to swell, and an attack of fever is not unlikely to follow. In that case the sufferer is placed on a rigid diet, which is enforced until the date at which a sort of scale (squame) forms over the wounds. In due time the scale falls, leaving apparent the regular outline and slaty hue of the pattern tattooed. Berchon says that the tattooers themselves share the fears of their clients respecting the possible and not improbable dangers of these prolonged and terrible processes; and that this apprehension explains in many cases their refusal to exercise their art on the officers of European vessels calling at their shores. "The naturalist Chemisso relates that the tattooers of Ordia resisted every demand of the Russian officers of Kotzebue's expedition."

The missionary Ellis ("Polynesian Researches," 1829) notes that "many natives suffer much from the swelling and inflammation consequent on the operation of tattooing," disorders which "have had a fatal termination." Moerenhout says: "At the age of eight or ten were commenced these painful operations, causes of suffering so intense that some of the victims succumbed, although the 'sittings' with the tattooer lasted only a short time." Mariner ("An Account of the Natives of the Tonga Islands," 1818) observes that where all remedies fail, the patients are "left to the natural course." Berchon cites several European cases where maladies consequent on tattooing have necessitated amputation, and others in which death has resulted. The minor accidents to be guarded against are numerous. The pathology of tattooing—a sufficiently important subject as may be inferred—received little or no attention until Dr. Berchon made it his own in the treatise named above.

HYGIENE.

Savage tribes, however, are far from neglecting the hygiene of the matter. The Oceanians have a whole manual relating to treatment after tattooing, to the aid of which is summoned all the authority of the taboo. Complete repose is enjoined, a careful diet, and deprivation from every physical indulgence. Among the emollients prescribed as protection against inflammation are various healing leaves.

The operation itself is not, as a rule, seriously begun

at a very early age. The tattooing of children and very young people is confined, for example, to the mere preliminaries of the process, "a few lines, a few signs on different points of the body; it is only by very slow stages that the ornamentation of the entire surface of the skin is completed," says Berchon. From his own observations in Polynesia he concludes that "it is the old men only who are magnificently blazoned from head to foot." Other circumstances in addition to that of the consideration of health may combine to delay the process of the "complete illustration of the human page;" the cost of tattooing, too high sometimes for the poorer members of a tribe; "the absence of an accomplished tattooer" in a given district, or the waiting for some renowned artist from a neighboring isle; sickness, dearth, protracted wars; all these causes may contribute to retard the operation, and they undoubtedly help to explain "the extreme slowness of the business of tattooing in Oceania." They are to be reckoned with, moreover (in conjunction with the preventive and remedial appliances everywhere employed in the Polynesian Archipelago), when the attempt is made to solve the question why this practice, with its grave inherent risks to health and life, is not constantly attended by results of the most serious nature. The rarity of pathological cases in Europe is explained chiefly by the smallness of the designs which the tattooer most often engraves on his clients.

The subject has still to be developed, and, as far as the documents will serve, concluded. It is only within the last five and twenty years that it has seemed worth while to write of tattooing as other than a curious practice of savages and a foolish practice of schoolboys. And in that period it has not occurred to anybody on this side of the Channel (if the disquisitions of a very small number of ethnologists be excluded) to write about tattooing at all. Germany has produced an elaborate volume. And in France and Italy it has engaged the serious attention of some three or four distinguished scientists, and has produced here an article, there a pamphlet, and elsewhere a compact treatise, of singular interest. These have not been exhausted in the cursory paragraphs of this paper. The medico-legal and other aspects of the subject remain for consideration.—Leisure Hour.

SOME INDIAN IDEAS CONCERNING ASTRONOMY AND METEOROLOGICAL PHENOMENA.

THE SUN AND MOON.

ACCORDING to Eskimo folk lore, a girl, at a time when darkness covered the earth, was nightly visited by some one whose identity she could not discover, but who finally turned out to be her brother. The father and mother were very angry and scolded the pair so severely that the son fled from their presence. The daughter seized a firebrand and pursued him. He ran to the sky to avoid her, but she flew after him. The girl who bore the torch became the sun (sirinirn), and the man changed into the moon, which is hence called aninga, "her brother." The sparks that flew from the brand became the stars. The sun is constantly pursuing the moon, which keeps in the darkness to avoid discovery. When an eclipse occurs, they are supposed to meet.

According to the Kootenays, the two sons of the wild cat created the sun (natanik) and moon (k'tsitlmeyet natanik, "night sun"). The elder turned himself into the sun, and by his brightness dispelled the gloom which the great black body and outspread wings of the raven had caused in the world; the younger, rising behind the mountains, became the moon. According to the Sia tradition, the two mothers, Utset and Nowatset, the first women created, having decided to provide a light for the world, made the sun out of white shell, turquois, red stone and abalone shell. Having done this, they carried him to the east and there made a camp. The next morning, they ascended a high mountain and dropped the sun down behind it, and after a time he began to ascend, and when the people saw the light their hearts rejoiced. Though the sun lighted the world in the day, he gave no light at night, as he returned to his home in the west, and so the two mothers created the moon from a slightly black stone, many varieties of a yellow stone, turquois and a red stone, that the world might be lighted at night. But the moon traveled slowly, and did not always furnish light. So the mothers created the star people and made their eyes of beautiful sparkling white crystal, that they might twinkle and brighten the world at night. In the cosmogony of the Hidery Indians, the creator of the world, Nekilstluss, in the shape of a raven, existed from all eternity. Before the world came into being, he brooded over the intense darkness that prevailed, until, after aeons of ages, by the continual flapping of his wings, he beat the darkness down to solid ground. For a long time, the only light in the world was a dim, hazy one, given off by the earth. When the earth was in a condition to receive the stronger light from the sun, moon and stars, he set out to get hold of them. They were in possession of a great chief, who had them in three separate boxes, kept them only for his own use, and refused to part with them. Nekilstluss, having obtained one of the boxes by a ruse, broke it open. It happened to be the sun that he had got, and this he took in his beak, and, flying up, placed it in the heavens, where it has been ever since. After this he obtained the two other boxes by another ruse, and, having broken them open, let out the moon and stars, which he placed in the heavens, where they have ever since continued to shine.

Examples of such myths as the above might be multiplied, but these few, selected at random, will suffice to give an idea of the notions held by the various tribes of North American Indians in regard to the origin of the sun and moon.

In a very large number of the Indian languages the name for the sun, moon and month is the same, but when it becomes necessary to be more explicit in regard to the two former, the sun is designated by a name signifying "day sun" and the moon by a name signifying "night sun." Among the Iroquois the sun is called karakwa entiekenekha, "the star that shines at midday," and the moon karakwa asontenkha, "the star that shines at midnight." Among the Creeks the sun is called ni'htag miki, "the day king." The Choctaw name for the sun is hushi, and that of the moon hushi ninak aya, "sun (that) goes along (at) night." The Thlinkit Indians of British Columbia distinguish the sun as "the male light" (kukan).

A figurative Cherokee term for the sun as an elemental god is une 'lanuhi, "the apportioner." In the Klamath language the name of the sun and moon is shapash, "the indicator," and here the moon has another name besides, viz., ukaukosh, "the broken one," "the one going to pieces." The Timucua term for the moon is akuhiba, "the one who tells." Analogous to the name signifying "indicator" of time, is the English word moon, meaning "the measurer" (of time).

Most Indian languages have different terms for the moon as a divider of time and the moon as appearing in different phases. There is a curious belief among the Dakotas that when the moon is full a great number of very small mice begin nibbling on one side of it, and continue so to do until they have eaten it all up. Hence, when the moon is on the wane, they say of it wiyaspapi, "the moon is nibbled." Soon after this another moon begins to grow, and goes on increasing until it has reached its full size, only to share the fate of its predecessors; so that with them the new moon is really "new," and not the old one reappearing.

The old tradition of the "man in the moon" exists among many Indian tribes. Thus, in one Eskimo tradition, the moon is a man carrying a glowing light, and in another she is the moon man's house. The natives believe that the man in the moon makes the snow. He is generally considered a protector of the poor, and sometimes descends from his house on a sledge drawn by his dog in order to help them. According to the tradition of the Teton, Hokewinla is a man who stands in the moon with outstretched arms. His name is said to mean "Turtle Man." When the Teton see a short man with a large body and legs they generally call him "Hokela," after the man in the moon. The same tradition exists among the Athabascans, and the Chippewyan name for the spots on the lunar surface is sa-kké-déné, "man on the moon," and sa-kké-weta, "he who lives in the moon." The Prairie Crees recognize a male divinity in the moon under the name of mustaté awasis, "buffalo child," corresponding to the Blackfoot kokoyé natus. It is this god, they claim, that sends the snow. When snow is descending in too great abundance, the Haves assert that they can make it cease by directing toward the moon a firebrand which they plant in the earth after the manner of a torch.

In some cases, the tradition has reference to a woman in the moon. Thus, the Mandans say that in the moon dwells the Old Woman who Never Dies. They do not know much about her, but they sacrifice to her as well as to other spirits. She has six children, three sons and three daughters, who inhabit certain stars. According to the Iroquois, an old woman, gifted with the power of divination, was unhappy because she could not also foretell when the world would come to an end. For this she was transported to the moon, where, to this day, she is plainly to be seen weaving a forehead strap. Once a month she stirs the kettle of boiling hominy before her, during which the cat, ever by her side, unravels her net, and so she must continue until the end of time, for never until then will her work be finished.

Various ideas are held among the Indians in regard to eclipses of the sun and moon. As Arctic earthquakes are coincident with eclipses of the moon, the Eskimo, of Alaska, say that an eclipse (pohlaroa) is the shadow of the earth being piled up and shaken. These phenomena create the greatest consternation among these people and almost paralyze them with fear. All the unutkoots (medicine men) in a village will howl and drum till it has passed, claiming that they have driven the thing away. Among the Nootoks all hands rally around a pair of buckhorns, form a circle, and march around to the music of drums and wild chants till the eclipse is off.

When an eclipse of the sun or moon occurs, the Odjibways say gisiss nibo, "the sun (or moon) dies," and the Crees, wanitibiskipayiw pisim, "the sun (or moon) becomes dark." The Choctaws say of an eclipse, hushi luma, "the sun (or moon) is hiding," and the Iroquois karakwasetha, "the sun (or moon) is hiding;" the Mohawks, onneontrakwaton, the Onondaga, ongwaterakkwaton, "we have eclipse;" the Dakota, wi-atanin-shni-iyaya, "sun (or moon) appears not to have gone down;" the Eskimo, of Mackenzie River, tchikreynœrertoark, "the sun conceals itself," or tatrarertoark, "the moon conceals itself;" Cherokee, atsigiska nungtaw, "the sun is being swallowed," etc.

THE PLANETS AND FIXED STARS.

According to the Kootenay Indians, the sun is a man and the moon a woman, while the stars are Indians who, from time to time, have ascended to the sky. Some of the Kootenays, however, say that the stars and the rainbow were made by the chicken hawk, who also made the sun and moon. The Mandans believe that the stars are deceased men. When a child is born, a star descends and appears on earth in human form; after death it reascends and appears again as a star in the heavens. Iroquois tradition asserts that the sun and moon existed before the creation of the earth, but the stars had all been mortals or favored animals and birds. In the Sia tradition of the origin of the stars, it is said that Utset, one of the two first women created, gave the Scarabæus a sack of stars to carry. The little animal did not know what the sack contained, but he grew very tired of carrying it and began to wonder what could be in it. In order to find out, he cut a tiny hole, when immediately the stars began flying out and filling the heavens everywhere. The little fellow, however, had saved a few of the stars by grabbing the sack and holding it fast. These Utset distributed in the heavens. In one group she placed seven stars (the Great Bear), in another three (part of Orion), in another group she placed the Pleiades, and throwing the rest far off into the heavens, exclaimed "All is well!"

Roger Williams in his Key into the Language of America (Narragansett) says:

> "The very Indian boys can give
> To many Starres their name,
> And know their course and therein doe
> Excell the English tame."

"By occasion of their frequent lying in the Fields and Woods, they much observe the Starres, and their very children can give the Names to many of them, and observe their Motions, and they have the same words for their rising, courses and setting, as for the Sunne and Moone."

The coyote is an important figure in the mythology of all our aborigines to whom he is known, and it is he who is responsible, say the Navajos, for the present irregular position of the stars in the heavens.

The Pole Star.—According to a tradition of the Iroquois, the pole star was pointed out to a party of lost Indians by the pygmies, into whose country they had wandered, and who told them that in the north, whither the sun never goes, while other stars move about, this particular star should stand still, as the Indian's guide in his wanderings, and they were then but to follow its light and they would soon return to their tribe.

Then they thanked the good pygmies, and traveled every night until they arrived safely in their homes, where, after they had recounted their adventures, the head chief called a meeting of all the tribes and said that they ought to give this star a name. So they called it tiynsoudagoêrr, "the star that never moves," a name by which it is called to this day. The pole star is called by the Crees kiwetinatak, "north star," and atak ekawâtch ka âttutet, "the star that never changes place." By the Choctaws it is called fulummi fichik, "north star," and fichik humma, "red star;" by the Kootenays, klowuhkla, "grizzly bear;" by the Hailtzuk, pâise; by the Odjibways, giwedinanang, "north star;" by the Chippewyans, yedhtaa thén, "north star;" by the Haves, yehta-fwen, "north star;" and by the Loucheux, zjiété-œn, "north star;" by the Creeks, oniblaakollaswan, "north star;" and by the Caddoes, anchkotsokas, "north star;" by the Cherokees, nâkwisi tsuyungtlung ehi, "the star inhabiting the north;" etc.

Venus.—Venus is called by the Iroquois tewentenha witha, "it brings the light;" by the Odjibways, wabananang, "morning star;" by the Nipissings, wâbananang, "morning star;" by the Crees, wâpanatak, "morning star;" by the Narragansetts, mishannock, "the big star;" by the Choctaws, fichik chito, "the big star;" by the Kootenays, guwitlitlnohos, "the big star;" by the Eskimo, of Alaska, ogaro; by the Eskimo, of Mackenzie River, ublurca-teudjink; by the Chippewyans, thén-thoré-tchér, "the big yellow star;" by the Haves, ttséyuné-chô-wéné, "star of the big woman;" by the Dakotas, wichankhpi tanka, "the big star;" by the Omahas and Ponkas, minkaké tanka, "the big star;" by the Hidatsas, ikhaikhtia, "the big star;" etc.

The Hidatsas regard Venus as the child of the moon, and account it as a great power. They assert that it was originally a Hidatsa, and the grandson of the Old Woman who Never Dies.

Jupiter, like Venus, is called by a name signifying "big star" by some tribes of Indians: Dakota, wichankhpi tanka; Kootenay, guwitlitlnohos; etc.

THE CONSTELLATIONS.

The Great Bear.—The constellation of Ursa Major is called by the Iroquois Okwari, "the bear." Once upon a time, says a tradition of these Indians, a party of hunters were in pursuit of a bear, when they were attacked by a monster stone giant, and all but three destroyed. The three, together with the bear, were carried by invisible spirits up into the sky, where the bear can still be seen, pursued by the first hunter with his bow, the second with the kettle, and the third, who, farther behind, is gathering sticks. Only in fall do the arrows of the hunters pierce the bear, when his dripping blood tinges the autumn foliage. Then for a time he is invisible, but afterward reappears.

By the Kootenay Indians the constellation is looked upon as a female grizzly bear, formerly an Indian woman in the time when man and the animals were pretty much the same kind of beings; hence its name, among these Indians, of tlautla, or "grizzly bear." By the Crees, Odjibways and Nipissings, the constellation is called, respectively, otchekatâk, otchiganang and odjiganang, all meaning "the star (constellation) of the fisher" (the animal otherwise known as the pekan). The Choctaw name is fichik issuba,* "star of the horse," and the Eskimo name is tuktukdjung or tuktuoruin "(constellation) of the reindeer." By the Hidatsa, Ursa Major is called ikhashapua, "the seven stars," and is said by them to be the ermine, the several stars of the constellation indicating, in their opinion, the burrow, the head, the feet and the tail of that animal. The Chippewyan name for the constellation is yetaa-thén-tchôr, "the big polar star," and the Have name, yeta. It is called by the Mackenzie River Eskimo ariarteat.

Among the Hailtzuk, of British Columbia, the constellation is called klaksoowis, "grizzly bear," and by the Narragansetts it was designated as mosk and paukunnawaw, both names in their language for a bear.

Among the Omahas and Ponkas, the seven stars forming the dipper are called wapaha thingkshe, "funeral bier."

Orion.—Three men, says an Eskimo tradition, went hunting with a sledge and took a young boy with them. When they approached the edge of the floe, they saw a bear and went in pursuit. Though the dogs ran fast, they could not get nearer, and all of a sudden they observed that the bear was lifted up, and their sledge followed. At this moment the boy lost one of his mittens, and, in his attempt to pick it up, fell from the sledge. There he saw the men ascending higher and higher, and finally being transformed into stars. The bear became the star Betelgeuse, nanukdjung, "the bear;" the pursuers became Orion's belt, udlekdjun, "following one another;" and the sledge became Orion's sword, kamutikdjung, "the sledge." Orion's belt, in the dialect of the Point Barrow Eskimo, is tuatsan, and in that of the Mackenzie River Eskimo tubatshan (from a verb meaning "to rise"), and in the language of the Hailtzuks, iliwl a. It was called by the Narragansetts swishcuttowauog, "they are three fires," it having been likened by them to an Indian long house in which three fires are burning.

* This name may have been originally fichik issi, "star of the deer," as the horse (the Choctaw name of which, issuba, means "deer that carries a burden") was, of course, unknown to the natives until the advent of the whites.

The Sia account of the origin of the three stars in Orion's belt has already been given. These three stars are called by the Hudson's Bay Eskimo siektung, "those standing in a row;" by the Chippewyan, yetaa-thehe, "southern tail;" by the Haves deninttchie, "old man;" by the Loucheux, kœt-etellœ; and by the Hidatsas, ikhadami, "the three stars."

Taurus, the Seven Stars of, or Pleiades.—Seven little boys, says an Iroquois tradition, were once accustomed to bring at eve their corn and beans to a little mound, upon the top of which, after their feast, the sweetest of their singers would sing for his mates, who danced around the mound. On one occasion they resolved upon a more sumptuous feast, but their parents refused them the needed supplies, and so they met for a feastless dance. Their sad hearts grew lighter as they danced around the mound, until suddenly the whole party whirled off in the air. Higher and higher they rose, whirling around their singer, until, transformed into bright stars, they took their places in the firmament, where, as the Pleiades, they are dancing still, the brightness of the singer [Merope], however, having been dimmed on account of his desire to return to earth.

The Pleiades are called by the Osages mikak'e upatse pethunpa, "the seven gentes of stars," or simply mikak'e pethunpa, "the seven stars;" by the Dakotas, tawamnipa or tayamnipa, "three pairs;" by the Choctaws fichik itulhpi, "the five stars" (perhaps the Hyades); by the Eskimos, of Alaska, patukturin, sekupcheluk and sheroopsatuk, and by the Central Eskimo sakietum; by the Hidatsas, ikhakhakhua, "stars set closely together," or "thickly studded;" by the Chippewyans, thén ttsozé, "fly stars," and thén-tchin-étéli, "stars collected together;" by the Haves, fwen-fweguwe, "stars clustered like worms," and fwen-tchin-enégéli, "stars collected in a heap;" by the Loucheux, sen-atlla, "stars aligned" or "strung."

The Lesser Bear.—The constellation of Ursa Minor is called by the Eskimo of Mackenzie River, tchivulik; by the Chippewyans, yétaa-thén-tséle, "the small polar star;" by the Haves, yeta-tchile, "the small polar star;" and by the Loucheux, yutié.

Cassiopeia.—This beautiful constellation is recognized by the Eskimo, of Point Barrow, Alaska, and called by them ibrosi.

Canis Major.—Sirius, the principal star of this constellation, is called by the Hidatsas ikhadehi, "the white star," and by the Hailtzuk, of British Columbia, kwakum, a name derived from the same root as the word for "daylight," and referring to its brightness.

Bootes.—Arcturus, the principal star of this constellation, is called by the Eskimo, of Alaska, sibwudli.

Lyra.—The star Vega is called by the Eskimo, of Alaska, agrulubwuk.

Aquila.—Altair, the principal star of this constellation, is called agru by the Eskimo, of Point Barrow, Alaska.

Some Other Star Groups.—An Iroquois tradition says that an old man, despised and rejected by his people, took his bundle and staff and went up into a high mountain, where he began singing the death chant. Those below, who were watching him, saw him slowly rise into the air, his chant ever growing fainter and fainter, until it finally ceased as he took his place in the heavens, where his stooping figure, staff and bundle have ever since been visible, and are pointed out as nagêtchi, "the old man."

The Omahas and Ponkas designate a certain cluster of six stars as ta-thapthin, "the three deer," and the Omahas recognize a similar group under the name of mingha si tanga, "the big goose foot."

THE MILKY WAY.

The Milky Way is regarded by some of the North American Indians as the pathway that the spirit, upon leaving the body, takes to reach the next world; hence the last act of the conjurer is to sing a song to conduct the spirit over this road, which is, for this reason, called by the Dakotas wanaghi tachanku, "the spirit's road," and by the Odjibways, tchibekana, "road of the dead." By the Hidatsas it is called by a name signifying "the ashy way," and by the Kootenays, akkemais-kaetltsin, "the trail of the dog." By the Hailtzak it is called kum-e-e, and by the Gaitchim, ohu-ute, words of uncertain meaning.

METEORS AND COMETS.

Meteors or shooting stars are, by some Indians, regarded as spirits of the deceased. The Tehiglit, who believe in the influence of the stars, think that a man dies every time that a meteor falls, and this belief is shared by the Chippewyans. The Dakota name for a meteor is wakan wokhpa, "mysterious falling;" the Hidatsa, ikhkapati, "falling star;" the Odjibway, anang pangishin, "star that falls;" the Choctaw, fichik hika, "flying star;" the Chippewyan, thénnaltthœri, "falling star;" the Loucheux, Scentsien, "excrement of the stars;" the Eskimo, of Alaska, ugluria-anaktua, "falling star;" the Eskimo, of Mackenzie River, anarktorkr; the Kootenay, Kanuks, "that which falls;" the Odjibway, tchingwan, "that which falls;" the Haida, Kaitzoonari, "falling star;" etc.

By the Choctaws, a comet is called fichik shobota, "smoking star;" by the Chippewyans, thén-thoré-tchior, "big yellow star;" by the Haves, fwen lleri; by the Loucheux, shœn-vitchi-konlié, etc.

THE AURORA BOREALIS.

According to the Hudson's Bay Eskimo, human souls, after death, go either to the upper or the under world. The latter is decidedly to be preferred as being warm and rich in food. There are the dwellings of the happy dead called arsissut—"those who live in abundance." On the contrary, those who go to the upper world will suffer from cold and famine; and these are called the arssartut, or "ball players," on account of their playing at ball with a walrus head, which gives rise to the aurora borealis.

The Mandans affirm that the northern lights are occasioned by a large assembly of medicine men and distinguished warriors of several northern nations, who boil their prisoners and slain enemies in huge caldrons.

To the Iroquois the northern lights were always the indication of coming events. Were they white, frosty weather would ensue; if yellow, disease and pestilence; while red predicted war and bloodshed.

The color beams and rays of light of the aurora borealis are regarded by some Indians as the spirits of the dead. Hence when these multicolored lights are undergoing their rapid changes the Crees say: Tchipayak ninihituwok, "the dead are dancing."

The Hidatsa name for this phenomenon is apakhiadakha, "burning sky," or amashitakoaamakhiti, "northern lights." By the Eskimo of Mackenzie River, it is called kioria, and also anayaluktuark, "it winds about and scintillates;" by the Chippewyans, yakkray, "celestial whiteness;" and by the Loucheux, yi-kraen, "whiteness of the sky;" by the Cherokees, utselungnunghi; by the Dakotas, makhpiyatanin, "visible heavens," etc.

THE RAINBOW.

The Mandans believe that the rainbow is a spirit that accompanies the sun. According to the Central Eskimo, the rainbow is the path that souls take to reach the moon, near which they find a large lake abounding with fowl and fish. According to the Zuñi tradition, the rainbow was the bow and the lightning the arrow that the sun father fashioned for the two children whom he created from his own being and who fell to earth for the good of all beings. According to the Sia, the rainbow is the product of the rainbow people, who were created to work in Tinia (the middle plain of the world) to make it more beautiful for the people of Haarts (the earth) to look upon; not only the elders making the beautiful bows, but the children assisting in the work. The Sia have no idea how or of what the bows are made. They do, however, know that the war heroes traveled upon them. The Minatavi call the rainbow the "cap of the rain." Once, say they, an Indian in the autumn caught a red bird that had mocked him, and released it after binding its feet together with a fish line. The bird saw a hare and pounced upon it, but the hare crept into the skull of a buffalo lying on the prairie, and as the line hanging from the bird's claws formed a semicircle, they imagine that the rainbow was, and is still, caused by that occurrence.

By the Dakotas, the rainbow is called wihmunke, "sun snare;" by the Odjibways, nagweiâb, "string of a snare;" by the Abnakis, managwan, "snare;" by the Crees, pisimweyâbiy, "cord of the sun;" by the Hidatsas, midia poka, "water head dress;" by the Chippewyans, odadzié-pilé, "spider's web," or oratsié-tsen-inllu, "the spider has stretched its web;" by the Haves, kotsié-ya-t'é naillu, "stretched by the spider across the heavens;" by the Loucheux, kudedzji-via, "spider's web;" by the Eskimo of Mackenzie River, kayviaron, "areh;" by the Zuñi, amitolane; by the Kootenays, innisimin; by the Haida, kwotsakwokun, "spider's web;" by the Creeks, osekiindaja, "the rain stopper;" by the Choctaws, hinokbitepulli; by the Caddas, ishanowin; by the Cherokees, utakwatâgi; by the Onondagas, onhiota; etc.

THUNDER, LIGHTNING AND RAIN.

By the Central Eskimo it is believed that lightning, thunder and rain are made by three sisters. One of these, Ignirtung ("she who strikes the fire"), makes the lightning by striking together two stones (pyrites*?). The second, Kadlu ("thunder"), makes the thunder by rubbing sealskins and singing; and the third sister makes the rain by urinating. The origin of thunder by rubbing a sealskin is an idea common to all the Eskimo tribes from Alaska to Greenland. Among the Hudson's Bay Eskimo thunder is supposed to be the voice and lightning the torch of two old women who have under their control large bags of water (the clouds) with which they run across the sky. As the water escapes from the seams of these, it falls to the earth in the form of rain.

The Sia notion is that thunder and lightning are produced by certain Thunder People and Lightning People and the rain by Cloud People. The Thunder People have human forms, with wings of knives, by the flapping of which they make a great noise, thus frightening the Cloud and Lightning Peoples into working the harder.

The Lightning People shoot their bows to make it rain the harder, the smaller flashes coming from the bows of the children. The Cloud People make the rain. The water for this purpose is brought from springs at the base of the mountains in gourd jugs and vases by the men, women and children, who ascend from these springs to the base of a tree and thence through the heart or trunk to the top of the tree, which reaches to the middle plain of the world; they then pass on to the designated point to be sprinkled.

According to the Athabascans, lightning is produced by the flashing of the eyes of a huge imaginary bird called iti, the flapping of whose wings and the wagging of whose tail produces the roar of the thunder.

This idea of the production of thunder and lightning by a large bird or mysterious winged being is widespread among the Indians of different families of the north and west. This mythical bird is called by the Crees piyesiw,† a word synonymous with "thunder." These Indians imagine that this divine bird sends flashes of lightning from its eyes, produces the noise of thunder by the flapping of its wings and shoots invisible and ignited arrows, which are thunderbolts.

The Iowa and Oto also suppose the thunder being to be a large bird, which they call tcheghita and wakanda ("sacred"), the latter being its peculiar title. When they first hear the thunder in the spring of the year they hold a sacred feast in honor of this god. The Winnebago call the thunder being Wakantchara. The Teton call the thunder beings (of which there are four varieties, although in essence there are but one) Wakinyan, "the flying ones." The thunder is the sound of their voices. The lightning is the missile of the winged monsters which live and fly through the heavens, shielded from mortal vision by thick clouds. These thunderers are of terrific proportions. They have large, curved beaks like bison humps, and do not open their eyes except when they make lightning; hence the archaic Teton name for the lightning, wakinyan tunwanpi, meaning "the thunder beings open their eyes."

The Mandan, also, believe that the thunder is produced by the wings of a gigantic bird, which, when it flies softly (as is usually the case), is not heard; but when it flaps its wings violently occasions a roaring noise. The glance of its eyes produces lightning. It breaks through the clouds and makes a passage for the rain. The isolated and peculiarly loud claps of thunder are produced by a large tortoise which dwells in the clouds. The belief of the Hidatsa is the same, and according to them the flapping of the bird's wings also produces rain. The Dakota name for the thunder bird, and also for thunder caused by it, is wakinyan; hence wakinyan hoton, "to thunder," literally, "the thunder bird makes his voice heard;" and wakinyan tonwanpi, sheet lightning, literally, "the thunder bird's look."

Among the Kootenay, thunder, and the bird that is imagined to produce it, is called numa. According to these Indians, lightning is caused by the arrows that the bird shoots. In the beginning, say the Kootenay, there were no clouds; there was only numa, the great thunder bird in the sky. By and by came along the coyote and his daughter. The thunder bird had no wife, so he took to himself the daughter of the coyote. The latter then made a little sack or bag, which he gave to the thunder bird's wife for a blanket. This blanket is the clouds which we now see in the sky.

According to the Iroquois, thunder, lightning and rain are produced by the beneficent thunder-god Hinan, who is ever accompanied by equally powerful assistants. It is believed by some of these Indians that it is their ancestors who thunder, and that they live under Niagara Falls. It is perhaps from a similar belief that has arisen the Nipissing (Algonquin) expression for "it thunders," viz., nishkatisiik ni nishomak, "my grandfathers are angry." W. R. Gerard.

* I. e., ignis, a name primarily for fire, and by extension for pyrites and lightning. The Eskimo, as well as the Chippewyans, obtain fire by striking two pieces of pyrites together.

† This name is a derivative from the word piyew, partridge. The Chippewyan name iti, too, is from it, partridge.

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